

Aging Transport Systems Rulemaking Advisory Committee

Task 3

Final Report

March 26th, 2001

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Executive Summary

This Report is provided to ATSRAC by the Task 3 Sub Committee as a conclusion to the work requested of them in September 1999.

The Task 3 sub-committee was made up of fifteen American and European engineers representing operators, OEMs, Regulators and wiring / wire testing specialist companies. The group met six times between Nov 99 and Nov 00 for two or three day periods.

During these meetings, the sub-committee determined the most appropriate means to address the subtasks, identified an action plan, assigned individual responsibilities, discussed general concepts and harmonized approaches to the different issues. Due to the nature of the work, most of the detail was established by individuals between meetings.

The Task 3 sub-committee addressed four sub-tasks which, after implementation of the resultant recommendations, will lead to both an improvement in the method for developing scheduled maintenance programs and an enhancement of the practices used during on-aircraft maintenance.

The main enhancements in maintenance criteria established by the Task 3 sub-committee are:

- 1) Development of an 'enhanced zonal analysis' logic that complements existing zonal analysis procedures. Application of this will permit appropriate attention to be given to wiring installations. It will be possible to select stand-alone visual inspections (either General or Detailed) and tasks to minimize the presence of combustible material.
- 2) Clarification of the definition of a General Visual Inspection and guidance on what is expected from performance of a Zonal Inspection.
- 3) Identification of Protection and Cautions to be added to maintenance instructions, thereby enhancing procedures that will lead to minimization of contamination and accidental damage while working on the aircraft.
- 4) Recognition of the need to revisit maintenance programs to ensure that appropriate instructions for continued airworthiness exist for single element dual load path design in flying control mechanical.

A dedicated chapter is assigned to the directed recommendations issued by the Intrusive Inspection Working Group. Due to late availability of these specific actions, T3SC were unable to develop appropriate responses in due time and ATSRAC agreed that these issues would be addressed by the WG tasked to develop the Advisory Circular.

Discussion frequently led to the observation that few of the new recommendations would be effective if insufficient time is provided to the engineers, mechanics and inspectors so that they can apply what they will be taught in new training syllabi. The Task 3 sub-committee has identified the need for an 'awareness enhancement' within aircraft maintenance that will lead the management of operators, OEMs and 3rd Party organizations to understand the need for changes in the way the business is done. Only then will the theoretical improvements envisaged by the authors be translated into evidence of better condition of the aircraft systems.

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Record of Revisions

Date	Revision
29 Sep 00	'1 st draft to T3SC'. Prepared for Task 3 WG review prior to ATSRAC meeting Oct 11 th /12 th .
9 Oct 00	'2 nd draft to T3SC'. Task 3SC comments added. Additional text proposed in Chapter 9. All changes in red and highlighted by change bar. ('Draft to ATSRAC Oct 11 th 2000' is identical to '2 nd draft to T3SC' but without red text and change bars)
16 Oct 00	'3 rd draft to T3SC'. Updated following ATSRAC meeting Oct 11 th /12 th . See revised text on pages 14, 21, 22, 37 and 54.
22 Nov 00	'4 th draft to T3SC'. Chapters 1, 2, 3, 6 and 10 updated. Working document for 6 th T3SC meeting.
8 Dec 00	'5 th draft to T3SC'. Updated to reflect discussion at 6 th T3SC meeting in Toulouse Nov 28 th -30 th .
21 Dec 00	'6 th draft to T3SC'. Updated to reflect T3SC written comments to 5 th draft and to include Executive Summary. Chapter 11 replaced with revised draft Intrusive Inspection Report Chapter 7 recommendations received on 19 Dec. Task 3SC response not yet included. Appendices added as scanned pages. ('Draft to ATSRAC January 2001' is identical to '6 th draft to T3SC' but without red text and change bars. Chapter number added in footer)
14 Mar 01	'7 th draft to T3SC'. Updated to include comments received from ATSRAC in Jan 01 and to address ALPA comments written in Dec00/Jan01. Changes made in Para 6.1 and 6.8. Additional caution added to Items 1, 2 and 5 in Chapter 8. Chapter 9 re-titled and all reference to 'Cultural Revolution' deleted. In Chapter 11, ATSRAC agreed to publish Final report without T3SC response to Intrusive Inspection action items. Recommendation 12.2.5 added.
26 Mar 01	Final version. Technically identical to 7 th draft but with no change bars in left hand margin and no reference to 'Draft'.

Chapter 1

1.0 Background

The FAA developed the Aging Non-Structural Systems Plan to address the recommendation of the White House Commission on Aviation Safety and Security (WHCSS) that states; *"In cooperation with airlines and manufactures, the FAA's Aging Aircraft program should be expanded to cover non-structural systems. "*

In order to fully address the WHCSS recommendation on aging systems, an Aging Non-Structural Systems Study team was formed. This team, led by the Transport Airplane Directorate, conducted an inspection of systems in several aging airplanes and met with the FAA Principal Maintenance Inspectors (tasked with oversight of major air carriers) in order to make preliminary evaluation of the need for additional work relative to the Commission's concerns. The team concluded that additional work was warranted and that industry involvement in this work was essential.

The FAA chose to address these recommendations through an Aging Transport Systems Rulemaking Advisory Committee (ATSRAC), determining this was the most appropriate way to provide a forum for the parties involved in addressing the WHCSS recommendations.

The elements of the aging systems plan were grouped into five major tasks, each incorporating one or more related elements of the plan. The individual task statements (as provided by FAA to the ATSRAC Chairman in Jan 99) are quoted below. Note that these may have been slightly modified in subsequent ATSRAC discussions.

Task 1: Sampling Inspections of the fleet

Conduct an in-depth survey of the condition of aging transport fleet systems and propose model-specific safety recommendations related to airplane systems that will eliminate or significantly reduce the hazards associated with the types of age-related degradation displayed by the fleet. Propose mandatory actions to address in-service airplanes. Recommend changes to certification and operations rules to address problems associated with aging systems. There are four subtasks to this effort.

Task 2: Review of fleet service history

Review service history, manufacturers service bulletins, manufacturer's service letters and applicable Airworthiness Directives for the aging transport fleet. Identify information which pertains to aging systems for possible mandatory action. The fleet to be reviewed should be the same as evaluated as part of the fleet evaluation program of Specific Task 1. There are three subtasks to this effort.

Task 3: Improvement of maintenance criteria

Maintenance procedures currently in use in the air transport industry may not adequately or proactively address aging non-structural systems. While it is not expected that this committee will define airplane model specific detailed maintenance activities, there is a need to define general criteria for maintenance and inspection activities which maintenance programs should exhibit to address aging systems issues. This task is therefore to improve general maintenance criteria for airplane systems to assure aging systems related problems are identified and corrected. This should be done by developing enhancements to the maintenance planning procedures, maintenance procedures, inspection procedures, inspection criteria, procedures for protection of systems during maintenance, and maintenance training programs to ensure that aging systems issues are adequately addressed. These enhancements, when applied to a specific airplane type should lead to development of an airplane model specific maintenance program which adequately addresses aging systems issues. There are five subtasks to this effort.

Task 4: Review and update standard practices for wiring

The Air Transport Association (ATA) has developed a specification for maintenance manuals for aircraft. In this document, Chapter 20 contains a section on “Standard Practices for wiring”. In support of the ATA specification, the manufacturers of aircraft develop a version of Chapter 20 which identifies data and procedures regarding each type of wiring component throughout the aircraft which has been approved for installation. Data from each product vendor is included. At any individual airline or repair station only part of this information is needed. The remainder of the manufacturer’s Chapter 20 material has the potential for confusing the maintenance personnel, so the material should be tailored to the specific requirement of each airline or repair station. There are two subtasks to this effort.

Task 5: Review air carrier and repair station inspection and repair training programs and recommend actions to address aging systems

Review air carrier and repair station training programs for non-structural systems inspection and repair to ensure that they adequately address aging wiring system components (wire, connectors, brackets, shielding, clamps, ground) and other non-structural systems. Incorporate the work of Tasks 1 through 4 as it applies to training.

Chapter 2

2.0 Terms of Reference

The Terms of Reference for the Aging Transport Systems Rulemaking Advisory Committee (ATSRAC) were defined in January 1999. These identified five specific tasks that were subsequently given to four sub-committees (working groups) for detailed review and analysis.

The following text (in italics) records the original Terms of Reference for the Specific Task 3 activity.

Following the formation of the Task 3 SC in Sep 1999, the team members analyzed the Terms of Reference and agreed on the best approach to satisfying the various issues raised.

This review led to some debate on the exact interpretation of certain aspects and, in a few cases, the validity of some issues under the 'aging systems' activity. Proposals were subsequently presented to the main ATSRAC committee by the Task 3 SC Chairman in the Jan 2000 meeting that identified modified objectives which were thought to address the areas of concern in a practical way.

These proposals were fully discussed during both the Jan 00 and Apr 00 meetings and, after some modifications, were agreed.

SPECIFIC TASK 3, IMPROVEMENT OF MAINTENANCE CRITERIA

Maintenance procedures currently in use in the air transport industry may not adequately or proactively address aging non-structural systems. While it is not expected that this advisory committee will define airplane model specific detailed maintenance activities, there is a need to define general criteria for maintenance and inspection activities which maintenance programs should exhibit to address aging systems issues. This task is therefore to improve general maintenance criteria for airplane systems to assure aging systems related problems are identified and corrected. This should be done by developing enhancements to the maintenance planning procedures, maintenance procedures, inspection procedures, inspection criteria, procedures for protection of systems during maintenance, and maintenance training programs to ensure that aging systems issues are adequately addressed. These enhancements, when applied to a specific airplane type, should lead to development of an airplane model specific maintenance program which adequately addresses aging systems issues. There are five subtasks to this effort.

Sub-task 3.1) Review and Revise Maintenance Steering Group (MSG) –3 Processes :

Revise Maintenance Steering Group (MSG)-3 processes to address catastrophic events associated with wire failures as MSG-3 review items. The revised processes should result in identification of wire and system failures which are catastrophic or reduce the ability of the crew to cope with adverse operating conditions; or which can induce these effects on other

systems with which they are associated, either physically or functionally; and identification of maintenance tasks, inspection thresholds, and inspection intervals for failures with catastrophic consequences. Failures of components which could negatively affect HIRF, lightning protection, and electromagnetic compatibility features should be addressed. The MSG-3 process is to be updated by July 2000, with maintenance programs updated as necessary by October 2000.

This was subsequently modified to read:

Sub-task 3.1) Review and Revise Maintenance Steering Group (MSG) –3 Processes:

Develop a logic process to be used during maintenance program development to permit appropriate attention to be given to potential deterioration of electrical installations (wiring) where such deterioration could lead to a safety related failure effect. The effect of the wiring failure on the equipment it serves may be assumed to be adequately addressed by existing methodology. Consideration is also to be given to failures that could cause unacceptable degradation of lightning, HIRF and electromagnetic protection.

The logic process (or processes) is required for retroactive application to the in-service fleet and for application on new models. This shall be available in 3rd quarter of 2000. That developed for new models shall be submitted to the ATA for consideration in the next issue of their MSG-3 guidelines.

Note

It was agreed with ATSRAC that the consideration given to Lightning / HIRF would be limited to the enhancement of visual inspections and the minimization of accidental damage / contamination of associated wiring installations. The revised Zonal Analysis Procedure specifically requires L/HIRF protection features to be highlighted and addressed (see Chapter 6.5).

It should be noted that during 2000 a dedicated ATA WG developed a new sub-chapter 2.6 in the MSG-3 document titled 'L/HIRF Analysis Procedure' for inclusion in the 2001 revision. This includes logic to identify scheduled maintenance tasks that may be required in addition to the visual inspections developed through application of the (enhanced) Zonal Analysis Procedure.

Sub-task 3.2) Define Improved Inspection Criteria :

Define improved inspection criteria for wiring, connectors, and associated components using ATA best practices, i.e. ATA Specification 117, Wiring Maintenance Practice Guidelines, pertinent manufacturer's service data, and DOD/NASA "lessons learned" pertaining to airplane maintenance practice. Wire in conduits or the interior of large wire bundles is not inspectable under the current "general visual inspection" definition. Further there are many areas in the airplane where it is difficult to see and fully inspect even the surface of wire bundles. Evaluate the current definition of "general visual inspection" and determine if it is still appropriate to wire and wire systems. An expected result of this review would be the incorporation of inspections, improved maintenance practices, revised definitions, or other actions to detect potentially catastrophic electric faults. Include inspection criteria for components whose failure might negatively affect HIRF, lightning protection, and electromagnetic compatibility features. The inspections, improved maintenance practices,

revised definitions, guidance or other actions to detect potentially catastrophic electrical faults are to be developed by January 2000 and should be incorporated in the work of Task 5.

Agreed as proposed.

Sub-task 3.3) Define Practices to Eliminate Wire Bundle Contamination During Maintenance :

Establish improved maintenance practices to prevent contamination of wiring and connectors with metal shavings or other harmful solids or fluids during maintenance of other components or modifications and repairs of airplane structure. Include those practices in appropriate maintenance instructions and training. The practices are to be prepared in the form of guidance material by January 2000 and should be considered in the work of Task 5.

Agreed as proposed.

Sub-task 3.4) Define Acceptance Criteria for Corrosion of Systems Components :

Define acceptance criteria for corrosion on flight control actuators, associated linkages, and hydraulic fittings, if they do not already exist in maintenance documents. Define limits for corrosion on these components based on manufacturer's service data, service history, and DOD/NASA "lessons learned". Provide recommendations to the FAA as to the acceptance criteria and on the means of incorporating these criteria into maintenance programs. Recommendations are to be provided by January 2000 and should be incorporated in the work of Task 5.

The scope of this subtask was driven by ATSRAC discussions on what systems other than electrical wiring are subject to aging phenomena that might lead to an impact on continued safe flight and landing.

Task 3 SC discussions focussed on the possibility of deterioration of hidden elements within flight control mechanical systems. The concept of single element, dual load path design has been used to comply with FAR 25.671. The condition of mating faces of either back to back plates or tubes within tubes cannot easily be determined. The fact that current maintenance programs do not require inspections of these surfaces suggests that existing means to ensure the continuous airworthiness of such designs may be inadequate.

ATSRAC subsequently concluded that SE-DLP design was the only non-wiring-related system that needed further consideration by Task 3.

Sub-task 3.5) 'Component Maintenance' (no title given)

Present maintenance practices often do not relate the results of maintenance activities on components removed and replaced during line maintenance to the original service problem. Propose a process to assure that components removed during maintenance are examined

for safety implications of the observed failures and the results are tracked back to the original service problem. This task is to be completed by July.2000.

The intent of this task was discussed within Task 3SC and concluded to be beyond the competence and expertise of the existing members. Consideration was given to expanding the group to introduce the appropriate knowledge base but it was eventually concluded that this subtask did not fit well with the other subtasks and ATSRAC should be asked to reassign (or cancel) the task.

The subsequent statement to ATSRAC advised the following justification for this position:

- Task is not specific to aging systems
- Several Industry WGs have been working on this, and associated issues, for some years.
- These groups are made up of specialists in reliability control/monitoring
- Progress is being made. Refer to ATA SPEC2000 program. For example, bar coding system
- T3SC formation is optimized for enhancement of maintenance criteria (tasks, inspections, accomplishment instructions, precautions). Members are experts in scheduled maintenance activity. Task 3.5 relates to non scheduled maintenance and reliability control.

Task 3SC advised that, in view of the extent of the aging system related work that is necessary, they wished to focus their efforts on Tasks 3.1 to 3.4 which address subjects specific to aging. They further proposed that since several WGs are already active in this field, it may not be sensible to dilute the specialist composition of those groups by requesting they also support an ATSRAC Task group.

Following debate in the Jan 00 ATSRAC meeting, subtask 3.5 was removed from Task 3. It was eventually dropped from ATSRAC activity.

NOTE

Definition of wiring

For the purposes of this report, and unless specified otherwise, the term wiring is used to indicate the installation of wires, connectors, clamps, contacts, tie wraps, etc. The term wiring does not refer to individual electrical system components, conduits, or circuit protective devices.

Definition of combustible

For the purposes of this report, the term 'combustible' refers to the ability of any solid, liquid or gaseous material to cause a fire to be sustained after the removal of the ignition source. The term is used in place of inflammable / flammable. It should not be interpreted as identifying material that will burn when subjected to a continuous source of heat as occurs when a fire develops.

Chapter 3

3.0 Work Organization

The group of specialists brought together to address Task 3 has at various times been referred to as Working Group 2, Task 3 Working Group and Task 3 sub-committee. Since the name is not important but there needs to be consistency, throughout this report the name of the group is referred to as Task 3 Sub-Committee, abbreviated to Task3 SC.

Task 3 Sub-Committee membership

Tony Harbottle	Airbus Industrie (chairman)
Norm Hennigs	Boeing
Gil Palafox	Boeing (from Sep 2000)
Frank Jaehn	Airbus Industrie
Martin Knecht	Fokker Services (representing AECMA)
Ric Anderson	Air Transport Association (ATA)
Randy Boren	Northwest
Tim Herndon	Delta
Martin Cheshire	Virgin Atlantic (from Mar 2000)
Fred Sobeck	FAA
George Sedlack	FAA
Tony Heather	CAA (representing JAA)
Henry Dyck	Transport Canada
Armin Bruning	Electromec
Dave Allen	SAE

Members of the group were selected for their experience and knowledge of electrical wiring design and installation, on-aircraft maintenance, maintenance program development and/or regulatory oversight of maintenance activities. A balance was achieved between OEMs, operators, regulators and wiring specialists. In accordance with the ATSRAC Operating Procedures (the 'Green Book'), Section IV(B)6, an outline of each member's work history was assessed with representatives from ATSRAC in order to confirm the individuals suitability for inclusion in the group.

Meetings held

1 st	Washington	Nov 16th-17th 1999
2 nd	Atlanta	Feb 8th-9th 2000
3 rd	London	Mar 21st-22 nd 2000
4 th	Toronto	Jun 20th-21 st 2000
5 th	Seattle	Sep 12th-14 th 2000
6 th	Toulouse	Nov 28th-30 th 2000

In view of the extent and diversity of the tasks allocated to the group, once a clear understanding had been obtained as to the expectations of ATSRAC, the group divided the

work into four 'products'. Each 'product' was given to a two/three man sub-group to work on between Task 3 SC meetings. The technical content was reviewed by the whole group throughout the development period with all members having the opportunity to contribute.

The four 'products' identified were as follows:

Product 1:

Based on tasks 3.1 & 3.2. Develop a logic process that can be applied to both new aircraft and in-service aircraft to ensure that appropriate attention is paid to age related deterioration of wiring/ wiring installations. This product will reflect the revised GVI definition.

Product 2:

Based on task 3.3. Develop recommendations to be followed in order to minimize the potential deterioration of wiring installations from the effects of contamination and accidental damage.

Product 3:

Based on task 3.4 (modified as agreed by ATSRAC on Jan 19th). Develop guidelines to permit appropriate attention to be given to flight control dual load path design during development of 'instructions for continued airworthiness'. Propose methodology that may be applied retrospectively to such features on in-service models.

Product 4:

Develop generalized recommendations to increase awareness of maintenance quality issues. This is aimed at highlighting the need for a corporate culture that places adequate attention on house keeping activities. This product will also provide guidance on the type of discrepancies that are expected to be addressed during general visual inspections. The recommendations will address all systems.

The concept of these 'products' was introduced solely as an aid to achieving the goals in the time allocated. Once the sub-groups had written draft text, Task 3 SC refocused on the specific ATSRAC tasking and dropped the term 'product'.

Chapter 4

4.0 Sources of Data

Regulators

- AC 43-XX; Prevention, Control and Repair of Corrosion on Avionics Equipment; FAA AFS-350, 1999 (not yet released)
- AC 43.13-1B; Acceptable Methods, Techniques and Practices - Aircraft Inspection and Repair; AFS 600; 1998
- AC 25-16; Electrical Fault and Fire Prevention and Protection; FAA ANM-100, 1991
- FAA Inspector's Handbook Bulletin 91-15 FAA Order 8300.15 titled 'Origin and Propagation of Inaccessible aircraft fire under in flight airflow conditions

Air Transport Association

- ATA MSG-3 Maintenance Program Development document; ATA; Sept 1993
- ATA specification 117 – Wiring Maintenance Practices / Guidelines; ATA; July 1998

NTSB

- Electrical Arcing of Aged Aircraft Wire; R Swaim, Chairman TWA800 Systems Group

SAE

- A Review of Smoke and Potential In-Flight Fire Events in 1999; Jim Shaw, ALPA

ATSRAC

- Task 1 and Task 2 Final Report; Randy Pope ASTF Chairman (Non-Intrusive Inspections, OEM Service documents, AD review)
- Task 1 non-intrusive inspection reports for individual aircraft types: A300, B727, B737, B747, DC-8, DC-9, DC-10, and L1011
- Transport Aircraft Intrusive Inspection Project; Chris Smith, Chairman of Intrusive Inspection WG

OEM

- OEM documents concerning maintenance practices, e.g. Aircraft Maintenance Manuals, Wiring Manuals, Trouble Shooting Manuals

Task 3 SC reviewed many other documents available from OEMs, Regulators and the media concerning aircraft wiring installations in order to have as much supporting data as possible to permit performance of their task.

Chapter 5

5.0 Enhancement of Inspection criteria

Note: The use of the word 'inspector' in this document is not an indication of the grading level/seniority of the person required to perform the inspection. It shall be understood to mean 'the person performing the inspection' and it is incumbent on the company to ensure that this person has the appropriate training.

5.1 BACKGROUND

The ATA MSG-3 (Maintenance Steering Group -3) document provides guidance on a logical means to identify a minimum list of applicable and effective maintenance tasks that maintain the inherent safety and reliability levels of the systems and structure of the airplane. These tasks and their corresponding intervals are published in the Maintenance Review Board (MRB) Report and are used as the basis for the first issue of each operator's approved Maintenance Program (Schedule). Though the use of MSG-3 is technically only a means of compliance, in practice, the MRB Reports of all FAR/JAR Part 25 aircraft type certificated since 1980 have used this logic process. Accordingly, the resultant maintenance programs identify levels of inspections that should be consistent in their definition, interpretation and application.

In practice, inspection definitions have been refined at various revisions of MSG-3 in order to improve consistency of application and to minimize differing standards between application on aircraft types. For example, the concept of Internal/External Surveillance Inspections and the Walk Around Check was deleted in MSG-3 Rev 1, thus simplifying the definitions of the inspections that could be selected.

The recent focus on the importance of visual inspections to identify conditions that might lead to undesirable failure conditions has identified that further clarification is necessary if a significant improvement is to be realized in this area.

Over the years, the application of these inspection levels has not been consistent. This concerns those developing maintenance programs as well as those performing inspections in the field. When this variation is added to the interpretations of other levels of inspection used in pre MSG-3 programs it becomes evident that the starting point in establishing uniform training of analysts and inspectors must first be to agree to a common interpretation of the inspection levels.

Since the determination of the necessary inspections starts with the development of the initial maintenance program, the Task 3 SC concluded that the ATA, through its MSG-3 WG, should address this issue.

MSG-3 Revision 2 gives the possibility to select three levels of inspection – General Visual Inspection, Detailed Inspection and Special Detailed Inspection. Further to a request from ATSRAC Task 3 SC, the definitions of these have been reviewed by ATA and agreement

has been reached on changes that will be incorporated in MSG-3 Revision 2001 targeted for April 2001.

The following text (in bold) is that which is expected to be included in the revised MSG-3 document.

5.2 GENERAL VISUAL INSPECTION:

A visual examination of an interior or exterior area, installation or assembly to detect obvious damage, failure or irregularity. This level of inspection is made from within touching distance unless otherwise specified. A mirror may be necessary to ensure visual access to all surfaces in the inspection area. This level of inspection is made under normally available lighting conditions such as daylight, hangar lighting, flashlight or droplight and may require removal or opening of access panels or doors. Stands, ladders or platforms may be required to gain proximity to the area being checked.

Of the three levels of inspection, the term General Visual Inspection (GVI) received the most attention from the MSG-3 WG. Experience in the field had highlighted that there are considerable differences in how a GVI is considered in airlines and this has led to inconsistencies in their effectiveness. Though OEMs have tended towards a common standard in defining the scope and expectations of a GVI it has been recognized that this effort has not always been adequately addressed in the operators working environment.

One of the more significant concerns with the previous definition was the lack of guideline concerning from what distance a GVI should be performed. It is obvious that this has a significant influence on whether or not a particular degradation will be noted but, with no guidance, some GVIs are being performed from greater distances than foreseen by those concluding the task to be applicable and effective. In line with assumptions already taken by most OEM's, it was agreed that GVIs should be performed from within at least touching distance unless otherwise specified. Thus a GVI of a vertical or horizontal stabilizer will generally require access stands but, in order to identify stabilizer damage due to birdstrike/FOD etc, it remains valid to refer to the routine walk around check as a GVI, this being specified as being performed from the ground.

Another concern related to the use of mirrors in performing a GVI. It is evident that if mirrors are not used some significant deterioration may not be evident and thus a more intensive level of inspection would need to be called up in order to detect such degradation. It was concluded that those defining the level of inspection necessary shall assume that the person performing the inspection has a mirror available and will use it (as far as is practicable without item dislocation) in order to determine the absence of obvious deterioration on the rear surfaces of components. The mirror is not to increase the intensity of the inspection but purely to ensure that all surfaces are examined for obvious signs of deterioration. It was highlighted that without such a revision to the definition a higher level of inspection would be required for the majority of zones thus rendering the GVI of questionable effectiveness.

5.3 DETAILED INSPECTION:

An intensive examination of a specific item, installation or assembly to detect damage, failure or irregularity. Available lighting is normally supplemented with a direct source of good lighting at an intensity deemed appropriate. Inspection aids such as mirrors, magnifying lenses etc may be necessary. Surface cleaning and elaborate access procedures may be required.

This level of inspection is often abbreviated to 'DVI' although the title intentionally does not include the word 'Visual'. The ATA MSG-3 agreed that the word 'visual' (previously written after 'intensive') might suggest that a Detailed Inspection is restricted to an examination using only eyesight. It was argued that this is an unnecessary limitation since the scope of such an inspection will always need to be explained in jobcard / workcard and therefore could also include the use of other sensory faculties. In particular, it was highlighted that a Detailed Inspection could include tactile assessment in which a component or assembly is checked for tightness/security. This is of significance when identifying applicable and effective tasks to ensure the continued integrity of such installations as bonding jumpers, terminal connectors, etc.

Though the term Detailed Visual Inspection remains valid for Detailed Inspections using only eyesight, it should be recognized that this may represent only part of the inspection called for in the source documents used to establish an operator's Maintenance Program. Task 3 SC thus recommends that the abbreviation 'DI' or 'DET'

5.4 SPECIAL DETAILED INSPECTION:

An intensive examination of a specific item, installation, or assembly to detect damage, failure or irregularity. The examination is likely to make extensive use of specialized Inspection Techniques and/or equipment. Intricate cleaning and substantial access or disassembly procedure may be required.

The ATA MSG-3 WG concluded that there was no need to amend this definition.

5.5 DISCUSSION

ATSRAC Task 3 SC worked with the ATA MSG-3 WG throughout the development period and fully endorses their conclusion. These definitions have been used in the determination of enhancements to the maintenance criteria that, once incorporated, will lead to a more consistent approach to the performance of General Visual Inspections.

It is Industry practice to develop a separate inspection program that is complementary to the Structures Program and the Systems & Power Plant Program. According to MSG-3 guidelines, this program is referred to as the Zonal Inspection Program (ZIP) and it consists of General Visual Inspections of the majority of the airplane. Note: The practice on 'pre MSG-3 airplanes' was not always the same and this leads Task 3 SC to recommend that the starting point for the 'Enhanced ZIP' must be a well defined Zonal Inspection Program. This is likely to lead to more work being required on the programs of some older aircraft types.

The inspections called for in the Zonal Inspection Program are identified by reference to the zone (usually a number or alphanumeric designation). The extent of the task is determined by the access requirements, i.e. what doors, access panels and/or equipment must be removed or displaced. The repeat interval is determined from consideration of several factors that might influence the probability of deterioration. However, in the ZIP task description, no mention is made of any particular item or feature. It is assumed that all systems and structural features evident with the quoted access will be subjected to the same level of inspection. Experience with pre MSG-3 programs suggests that mentioning that particular attention should be given to specified items leads to 'tunnel vision' on the part of the person performing the inspection with a consequent risk that inadequate attention may be paid to features not specified.

It is possible for a General Visual Inspection to exist as a stand-alone task in either the Systems & Power Plant or Structures Program. In such cases, the task description can clearly identify any need to focus on a specific feature. In practice, most GVIs identified as applicable and effective from application of MSG-3 logic are considered adequately covered by the ZIP and thus do not appear as dedicated tasks. Analysts have an option to upgrade those that are not considered covered by the ZIP to Detailed Inspection.

As a result of the above practices, Task 3 SC believed that it would be beneficial to provide guidance on the type of deterioration that a person performing a GVI would be expected to notice and address. Though it may be realistically assumed that all operators provide such guidance to their inspectors it is evident that significant variations exist and, in certain areas of the world, a significant enhancement of the GVI could be obtained if internationally agreed guidance material could be produced. Though this is recognized as an ambitious target, text has been generated which is proposed to be incorporated in operators training material and in the introductory section of maintenance planning documentation. This text is proposed in Chapter 7 of this report.

5.6 RECOMMENDATIONS

Task 3 SC recommends that the following actions be taken:

- 1) The ATA's Maintenance Program Development Document that contains the MSG-3 guidelines is to be updated to reflect the revised definitions of General Visual Inspection and Detailed Inspection. Target: MSG-3 rev 2001.
- 2) Training material utilized by regulators, OEMs, operators and 3rd party maintenance organizations to be updated to reflect the revised GVI/DET definitions.

(Note that a recommendation to provide clarification of the type of deterioration that is expected to be seen and addressed during accomplishment of a zonal GVI is developed from Chapter 7 of this Report. This includes a recommendation to update introductory sections of OEM and operator's maintenance planning documentation to include guidance on expectations of a GVI)

Chapter 6

6.0 Maintenance Program Enhancement

6.1 Scope

Task 3 SC committed to working with facts generated by specialists familiar with the design, operation and maintenance of commercial airplanes. Consideration was also given to issues that had been identified in military/government areas of aviation where the possibility of read across to the civil sector could not be ruled out.

During the period that Task 3 SC developed enhanced maintenance criteria, the driving force was the results of the non intrusive inspections performed by the ASTF under ATSRAC Task 1. During the latter part of development of these criteria, conclusions and recommendations from the intrusive inspections became available. Task 3 SC consideration of these specific issues is recorded in Chapter 11.

The development of an enhanced maintenance program procedure was based on a need to consider additional tasks to address discrepancies that are visible, (i.e. without the need for specialized inspection techniques). During the development period, no facts were tabled to justify a logic process that could lead to the identification of Special Detailed Inspections (SDET). When data became available, as recorded in Chapter 11, consideration of the type of failure modes detected in the intrusive inspections did not lead Task 3SC to modify the generic logic procedures. However, some specific recommendations regarding the use of SDET procedures were formulated.

Task 3 SC considers that the results of their study shall be applicable to all Transport Category certificated airplanes. The 8 airplane types surveyed by the ASTF have been selected in consideration of their age and thus their ability to provide inputs on enhancements that are necessary. Unlike the Task 1 activity, Task 3 is not specific to aircraft type.

Though the ATSRAC activity is driven by the need to assess age-related deterioration of systems installations, the findings from Task 1 activity highlighted that the most likely cause for deterioration is associated more with time in service than with pure aging phenomena. With increasing time in service there is clearly an increased probability that mechanical damage, contamination, improper repairs and inadequate maintenance may occur. Taking these contributors as the primary causes of deterioration, Task 3 SC agreed that, since they could occur at any age, there is no justification for identifying high initial intervals followed by more frequent repeat inspections. Thus any pure aging influence is not specifically addressed within the scope of Task 3 SC activity.

The initial focus of the ATSRAC activity was on wiring, with the determination of any need to enhance the maintenance of other systems to be defined later. Following extensive discussion, ATSRAC concluded that there is, today, no evidence to suggest that deterioration of other systems might lead to a direct airworthiness condition in the same way as had been concluded for electrical wiring. As a result, the Task 3 SC enhanced logic methodology addresses only the wiring issues.

Task 3SC considered the limited data from ASTF concerning wire type. It was argued that there is no benefit to introduce methodology that will permit the selection of more intensive inspections on wires of particular types. This is because:

- (a) it is assumed that any wiring in zones where there is combustible material (such as dust/lint or fuel vapor) is already assessed as a candidate for detailed inspection, and
- (b) zonal analysts cannot be aware of which zones may be subjected to repairs / modifications that lead to the introduction of wire types different from those used by the OEMs. They either have to assume that the correct type of wire is used for the application (in which case there is no increased concern) or they pessimistically have to assume that an inappropriate wire type is used (in which case all wiring would need to be handled the same way).

Task 3SC made the assumption that wire insulation will continue to burn after the ignition source is removed only when it is contaminated by a combustible material (e.g, dust/lint). They consider that the use of any material that would continue to burn after removal of an arc source is contrary to regulations and will, if necessary, be addressed by specific recommendations (e.g, as occurred with mylar insulation blankets). There is thus no need to modify the generic enhanced zonal analysis procedures to permit the identification of dedicated tasks associated with wire types that are determined to be combustible in their own right (e.g, PVC coated wiring). In order to avoid this issue being overlooked, Task 3SC recommend to FAA that, should such materials be proven to require specific attention, they should follow-up any necessary actions with the concerned parties.

6.2 Current MSG-3 Zonal Analysis Procedures (MSG-3 Rev 2)

The existing MSG-3 guidelines Section 2.5 identifies the need for a Zonal Inspection Program (ZIP) and provides an outline procedure. This procedure leads to the identification of general visual inspections of the majority of the zones of the aircraft. The extent of the inspection is determined by the access requirement and the interval is defined according to susceptibility to damage, the amount of activity in the zone and previous experience with similar systems, powerplants and structures.

The Zonal WG that defines the GVIs that constitute the ZIP make a full assessment of the structure and systems installations within each zone and use this knowledge to determine access and interval. To avoid possible 'tunnel vision', the task description intentionally does not refer to any specific components or types of degradation.

6.3 Concerns relating to the adequacy of existing Zonal Inspection Programs

As a result of accident/incident investigations and surveys of in-service aircraft, it has been highlighted that the condition of aircraft system installations may not be receiving sufficient attention during the routine scheduled maintenance activity required by approved maintenance programs.

Though specific system functions may be adequately addressed through dedicated operational and functional checks, it is perceived that the condition of the installations, particularly the wires, pipes and ducting that connect system components, receive inadequate attention.

There is concern that in certain cases a GVI may be inadequate to confirm the continuous airworthiness characteristics of an installation. In addition, the application of the GVIs may not be performed in a consistent manner and thus improvements need to be identified to ensure that these inspections are effective.

6.4 Enhancement of scheduled maintenance programs

The objective of Task 3 SC was to identify a logical means that could be applied to in-service aircraft and new designs to ensure that adequate consideration is given to potential deterioration of system installations. The target was to develop a common process for old and new designs though it was recognized that some variation may ultimately be necessary in view of the variance in availability of design data.

Today, reliance is placed on the Zonal Inspection Program to address deterioration of the components that constitute system installations. Task 3 SC have reviewed the current ZIP philosophy with the objective to:

- (i) identify its limitations, and
- (ii) to propose improvements that could lead to a more consistent application of the GVI requirements.

The following text addresses (i). The improvements associated with (ii) are described in Chapters 5 and 7 of this report.

Task 3 SC recognized that the starting point for any enhancement must be the MSG-3 logic process that has been used to develop scheduled maintenance requirements since 1980. However, this logic could not have been used in the creation of the original maintenance programs for the older airplane types. As a result, since the focus of ATSRAC is on these older airplanes, before the proposed enhancements are developed, there is a need to have a collection of general visual inspections of each zone that can be regarded as equivalent to the Zonal Inspection Programs identified on later types.

MSG-3 provides procedures to develop three separate programs that together constitute the initial list of tasks to be included in an operators approved Maintenance Program. The procedures for these programs – Systems & Powerplant, Structures and Zonal Inspection – were reviewed in order to determine if they could be adapted to address the industry concerns and thus provide the necessary enhancements. In addition, the idea of a fourth program was considered.

After much discussion it was concluded that a change to the procedures used to develop the Zonal Inspection Program offered the best route to achieving the objectives.

6.5 Enhanced Zonal Analysis Procedure

The changes that are proposed to the Zonal Analysis procedure are introduced in order to identify the limitations of a GVI performed within a Zonal Inspection Program. The aim was to create a logical process whereby an analyst can determine whether a GVI accomplished as part of a zonal inspection is adequate or whether either a standalone GVI or a Detailed Inspection of specific items is justified. In addition, the logic includes a means to identify

dedicated tasks that would lead to the minimization of local accumulation of combustible material.

Task 3 SC developed a logic diagram for the existing MSG-3 Zonal Analysis (not previously available) and then through a series of iterations, modified this to address the need to be able to identify tasks other than zonal GVIs.

Throughout the exercise, Task 3 SC were aware that the final result must be practicable and must lead to the necessary reinforcement of maintenance programs. This would not be achieved by declaring a need to perform, for example, Detailed Inspections of all wiring. The focus of the team's efforts was thus directed at identifying as simple a logic as possible that would lead to the addition of new tasks only where they are justified.

The logic diagram developed (see Figure 6.5.1) was concluded to be suitable to determine:

- (a) enhancements to the maintenance programs of the in-service airplane types, and
- (b) identification of appropriate tasks during development of maintenance programs for new aircraft types.

With respect to (b), it was agreed that the question concerning proximity of wiring to primary and back-up flight controls need not be included. See paragraph (i).

The supporting text in this Chapter 6.5 was developed primarily for OEMs to use to enhance existing programs. It is considered unnecessarily detailed for introduction into the MSG-3 guidelines document, the information being more suitable for inclusion in the OEM's Policy and Procedure Handbooks. However, Chapter 6.6 provides text developed by Task 3SC that has been accepted by ATA for inclusion in MSG-3 Rev 2001. This text is considered to provide sufficient information to ensure that appropriate attention is given to the Enhanced Zonal Analysis.

The purpose of the original MSG-3 zonal analysis methodology was to identify Zonal Inspections to detect damage or deterioration of structure and system installations for which no specific inspection task had been created. This took into consideration the potential for accidental damage, the influence of local environment (temperature, vibration, etc) and the risk of damage subsequent to a system failure (eg fluid leaks). In addition, an assessment was made as to whether GVIs arising from MSI/SSI analysis could be considered as covered by the Zonal Inspections.

Task 3SC first created a formal logic diagram to address this process (identified as the 'standard' zonal analysis) and then, using this as a basis, developed it so that appropriate attention could be given to deterioration of electrical wiring. The revised part is referred to as the 'enhanced' zonal analysis procedure. Since users will perform a single zonal analysis procedure it is not relevant to continue this distinction after completion of ATSRAC activity. Consequently it will simply be referred to as the typical Zonal Analysis Procedure in published documents.

Unlike the original zonal analysis methodology, application of the enhanced procedure leads to the identification of Restoration (e.g, cleaning) tasks, Detailed Inspections and stand-alone GVIs as well as Zonal Inspections. Consequently the revised zonal analysis methodology leads to more than just a list of GVI tasks to be included in an operator's Zonal Inspection Program.

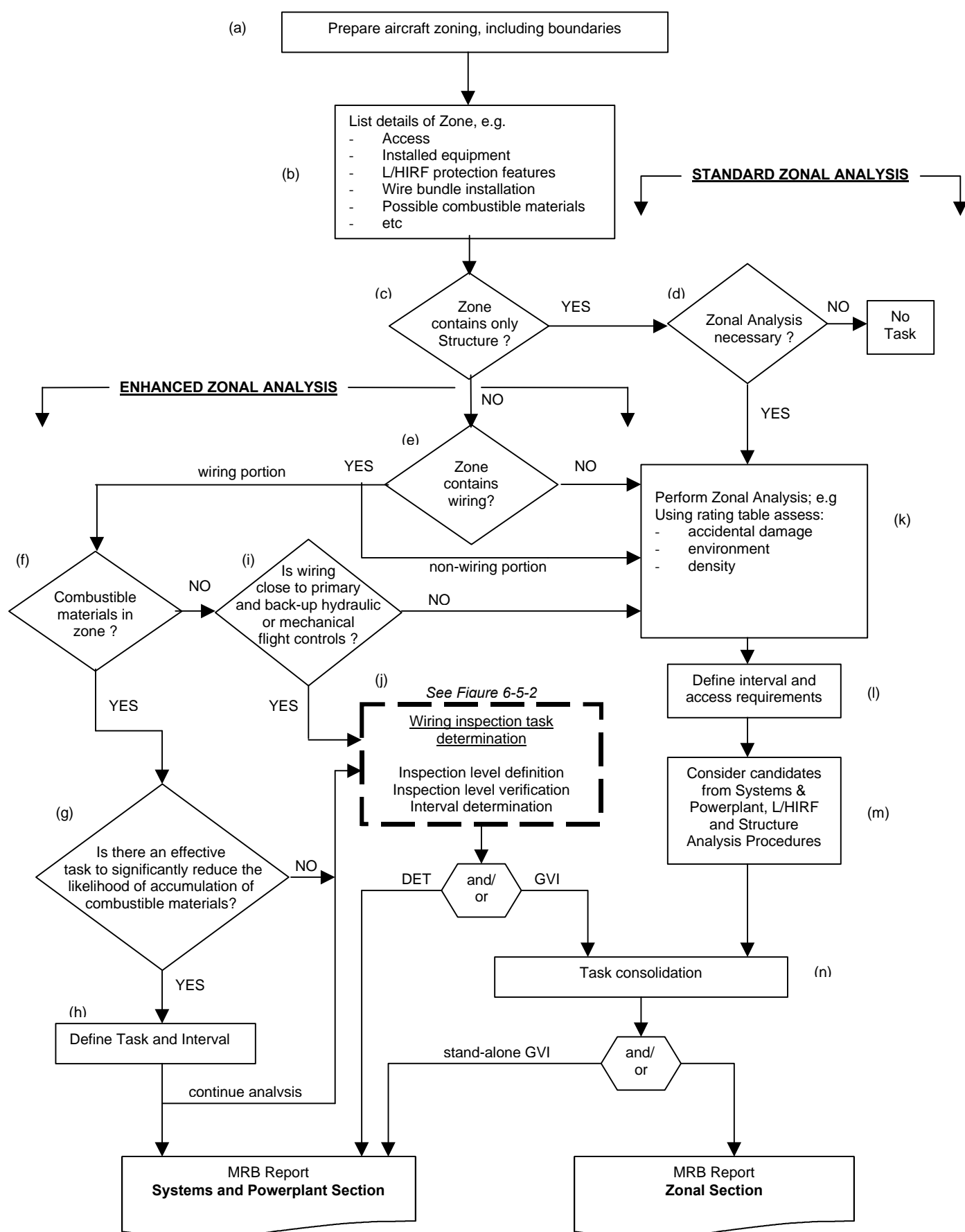
The enhanced part of the Zonal Analysis Procedure is performed on zones that contain wiring. It consists of:

- an assessment of the potential sources of combustible material within the zone either occurring due to contamination (e.g, dust/lint or fuel vapor leaks) as a result of design (e.g, fuel vapor in tanks)
- identification of effective tasks that would minimize the build-up of combustible contaminants (e.g, cleaning to remove dust/lint) or minimize the occurrence of combustible contaminants (e.g, DET of a particular pipe running alongside a harness)
- an assessment of the potential for a localized wiring fire (in a zone with no combustible materials) to disable adjacent flight control systems such that continued safe flight and landing might be jeopardized
- definition of the most appropriate restoration task and determination of a suitable repeat interval
- definition of appropriate inspection level for wiring in zones that may be subject to combustible material
- determination of suitable intervals for the defined inspections

An applicable rating system has to be developed to allow the definition of the inspection level for installed wiring and also a rating system for the definition of a task interval .

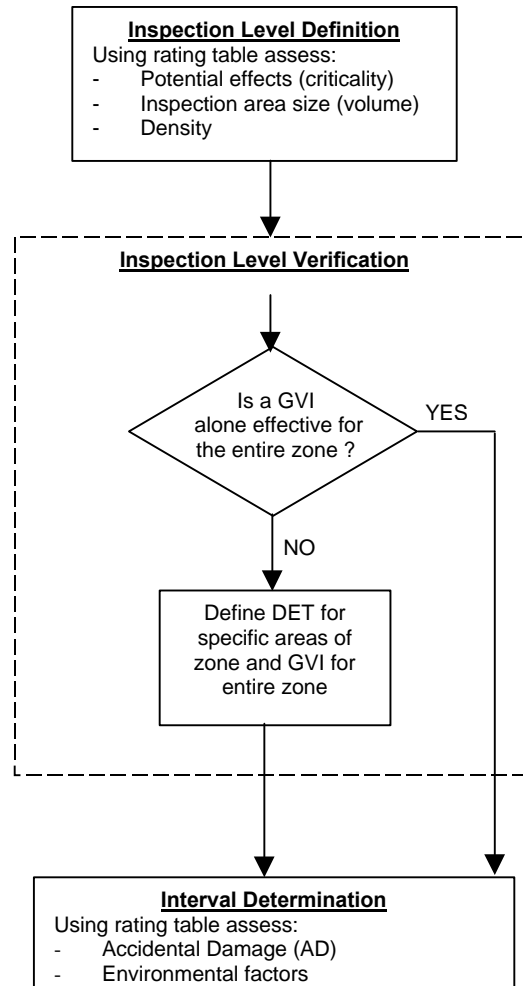
Zonal Analysis Procedure

Figure 6.5.1



Wiring inspection task determination

Figure 6.5.2 (see figure 6.5.1 for higher level)



The following paragraphs provide further explanation of each step in the logic.

a) “Prepare aircraft zoning including boundaries”

The system adopted is based on ATA iSpec 2200 (formerly ATA Spec 100), Chapter 1-6-0 and essentially complies with the rules of this system, varied only to accommodate particular design constructional differences.

The system consists of Major Zones, Major Sub Zones and Zones.

The zones, wherever possible, shall be defined by actual physical boundaries such as wing spars, major bulkheads, cabin floor, control surface boundaries, skin, etc.

b) “ List of Details of zone”

An evaluation will be carried out to identify system installations, significant components, L/HIRF protection features, typical power levels in any installed wiring bundles, combustible materials (present or possible accumulation) etc.

With respect to power levels, the analyst should be aware whether the bundle consists primarily of main generator feeder cables, low voltage instrumentation wiring or standard bus wiring. This information will later be used in determining the potential effects of deterioration.

The reference to combustible materials highlights the need to assess whether the zone might contain material/vapor that could cause a fire to be sustained in the event of an ignition source arising in adjacent wiring. Examples include the possible presence of fuel vapors, dust/lint accumulation and contaminated insulation blankets. See also under (f) for further information.

For aircraft types whose design directives may not have excluded the possibility of inadequate segregation between systems, the analyst should identify locations where both primary and back-up flight controls are routed within 2inches/50mm of a wiring harness. This information is required to answer question (i)

c) “Zone contains only Structure?”

This question serves as a means to eliminate those areas that do not contain any systems installations. Such zones may be covered by the Structures Analysis and may need no Zonal Analysis.

d) “Zonal Analysis necessary?”

The response to this question depends on OEM philosophy. A Zonal Inspection may be identified or a decision may be made that the GVI of the zone is covered by the Structures tasks.

e) “Zone Contains wiring?”

This question serves as a means to eliminate from the enhanced zonal analysis procedure those zones that do not contain any wiring. Such zones are analyzed using the standard zonal analysis procedure

f) “Combustible materials in zone?”

This question requires an evaluation of whether the zone might contain combustible material that could cause a fire to be sustained in the event of an ignition source arising in adjacent wiring. Examples include the possible presence of fuel vapors, dust/lint accumulation, contaminated insulation blankets.

With respect to commonly used liquids, e.g, oils, hydraulic fluids etc, the analyst should refer to the product specification in order to assess the potential for combustibility. The product may be readily combustible only in vapor/mist form and thus an assessment is required to determine if conditions might exist in the zone for the product to be in this state.

Generally, liquid contamination of wiring by oil and most hydraulic fluids (e.g, skydrol) need not be considered as capable of sustaining an ignition source unless it occurs in a zone where it causes adherence of significant dust and lint.

Products to inhibit structural corrosion need not be considered as capable of sustaining an ignition source.

Contamination by moisture (whether clean water or otherwise) need not be highlighted since, although it may increase the probability of arcing, it does not increase the combustibility of the material around a breach in the wiring insulation.

Any material in an uncontaminated state that, under certain conditions, may support a fire (e.g, mylar insulation blankets and PVC wiring insulation) need not be addressed in this logic. It shall be assumed that any necessary actions to address such issues will be handled in specific OEM documentation (e.g, by Service Bulletin).

The analyst should assess what sources of combustible products may contaminate the zone following any single failure considered likely from in-service experience. Unshrouded pipes having connections within the zone are to be considered as potential contamination sources. Inherent ventilation in the zone should be taken into account when determining the potential for subsequent combustion. This influences the response to the question of how near to the harness the source must be for there to be a concern.

Avionics and instruments located in the flight compartment and equipment bays tend to attract dust etc. In view of the heat generated by these components and the relatively tightly packed installations, the analyst shall consider these zones as having potential for combustible material. Thus the enhanced logic shall always be used for these zones.

g) “ Is there an effective task to significantly reduce the likelihood of accumulation

This question is to evaluate if there is an effective task that can significantly reduce the presence or accumulation of combustible materials within the zone.

Though restoration tasks (e.g. cleaning) are the most likely applicable tasks, the possibility to identify other tasks is not eliminated. A detailed inspection of a hydraulic pipe might be assessed as appropriate if high-pressure mist from pinhole corrosion could impinge a wire bundle and the inherent zone ventilation is low.

h) “Define Task and Interval ”

This step will define an applicable task and an effective interval. It shall be included as a dedicated task in the Systems & Powerplant section. Within MRB Reports, this may be introduced under ATA 20 with no Failure Effect Category quoted.

i) “Is wiring close to primary and back-up hydraulic or mechanical flight controls?”

This questions addresses the concern that on older aircraft types the application of design directives to ensure adequate segregation between primary and back-up flight controls may not have been as thorough as on later designs. Even in the absence of combustible material, a localized wire arcing could impact continued safe flight and landing if hydraulic pipes or mechanical cables are routed in close proximity (i.e, within 2ins/50mm) to a wiring harness. In consideration of the redundancy in flight control systems, the question need be answered ‘Yes’ only if both the primary and back-up system might be affected by wire arcing. Note that in zones where a fire might be sustained by combustible material the enhanced logic will automatically be followed.

NOTE

This question does not need to be asked if the original design directives required that adequate segregation exists between wiring harnesses and flight controls such that a localized wiring fire could not lead to loss of aircraft control. This position is supported by the fact that more recent types have less dependence on mechanical flight controls and much more importance has been placed on separation and segregation of flight control systems than was the case in the past. For the purposes of this study, it is considered that post FAR/JAR 25.1309 aircraft designs will have adequate segregation between critical systems. This implies that the question is necessary on aircraft receiving their initial Type Certificate prior to the early 1970s. Where there may be an element of doubt, the question should be included in the logic for that type.

On all aircraft types irrespective of TC date, modifications performed by STC holders may not have taken into account the OEM’s design directives. It is thus recommended that STC holders assess their design changes with this question included in the logic unless they can demonstrate that they followed equivalent installation directives.

This question will not be included in the MSG-3 Rev 2001 guidance material since that document will be used only to address new designs.

(j) “Wiring inspection task determination”

This contains 3 sub steps that are detailed in Figure 6-2.

(1) Inspection level definition

A rating system is used to define the most applicable Inspection level. The exact format of this will be determined by the analyst. The Inspection level characteristics to be included in the rating table are:

- Potential effects of fire on adjacent wiring & systems

- Inspection area size (volume)
- Density of installed equipment within the zone

Credit may be taken for the effectiveness of any task selected to minimize the accumulation of combustible material in the zone.

The intention is to conclude that in a zone that both (a) contains wiring and (b) either has potential for accumulation of combustible materials or has wiring in close proximity to primary and back-up flight controls, a detailed inspection of the wiring may be justified:

- the greater the critically of a localized fire,
- the larger the inspection area and
- the higher the density of the equipment in the zone.

The analyst shall assess the potential effect of a localized fire on adjacent wiring and systems. The rating applied depends on the potential for loss of redundancy such that continued flight and safe landing may not be possible. The analyst does not need to assess the function controlled by the wire that has the deterioration (the effect on system operation is assessed in standard MSG-3 application).

It is considered that the smaller the zone and the less congested it is, the more likely it is that the inspector will identify deterioration by General Visual Inspection.

The intention is to call for a wiring DET only when justified by these three criteria. This is expected to ensure the appropriate focus and avoid extensive detailed inspection requirements

(2) Verification of the selected inspection level

The rating tables identify the need for either a Detailed Inspection or a General Visual Inspection of the wiring within a zone. However, there may be justification that within the same zone some wiring may be more vulnerable than others and thus there needs to be a discussion on whether the same Inspection Level is appropriate for all wiring in the zone.

The verification serves to determine an applicable and effective Inspection Level for wiring in the zone. This can be

- General Visual Inspection of all wiring within the whole zone, or
- A combination of a Detailed Inspection for specific areas within the zone (eg wiring bundles routed in the floor) and a General Visual Inspection for other wiring in zone. In this case an applicable task combination should be selected. Note that in practice the GVI will apply to all the wiring in the zone since it is impractical to suggest that the inspector does not look at wiring subjected to DET.

Note that it is possible for the 'specific areas' to include all the wiring in the zone. However, for access reasons, the task interval may be different and therefore the analyst is not given the option to simply select a DET of all wiring in the zone.

(3) Definition of interval

The definition of an effective Interval will be carried out using a rating system. The characteristics for wiring to be rated should include:

- Possibility of Accidental Damage
- Environmental factors

The rating tables shall be designed to define increasing inspection frequency with increasing risk of accidental damage and increasing severity of the local environment within the zone.

Note:

At this point the analyst will have determined the inspection level and interval but no decision has yet been made as to whether the GVI (if selected) can be considered accomplished as part of the Zonal Inspection Program.

k) “Perform Zonal Analysis”

This reflects the initial zonal evaluation process (the Standard Zonal Analysis) and will be carried out on all zones except, according to OEM policy, those containing no systems installations. Typically, a rating system is used that takes into account the following characteristics:

- Possibility of accidental damage
- Environment
- Density of installed equipment

In this analysis, no special attention is placed on electrical wiring. Wiring may be considered fully covered by the Enhanced Zonal Analysis.

l) “Define interval and access requirements”

The interval will be selected to be the optimum value taking into consideration the likelihood of deterioration and the potential contribution of that deterioration to continued airworthiness, operational efficiency and economics. The selection will take into account access requirements and operator practice for similar areas.

m) “Consider candidates from System & Powerplant, L/HIRF and Structure Analysis

GVI tasks may be identified through application of the logic process used to determine Systems & Powerplant (MSI) and Structure (SSI) tasks. These GVIs may subsequently be determined as adequately covered by the Zonal Inspections identified by application of the

Standard Zonal Analysis. In this case they do not appear as dedicated tasks in an operator's program.

Before the Zonal WG confirms a suitable zonal inspection interval, the MSI/SSI transfer items that are candidates for coverage by the Zonal Inspections must be reviewed. Each transferred item/task will already have an interval and access requirement defined by the respective Working Group. The Zonal analyst shall determine whether the task can be considered covered by the Zonal Inspection tasks identified according to boxes 'k' and 'l'. The Zonal Working Group may chose to reduce the frequency of a task in order for this to be satisfied.

Not all GVIs developed from Structure and System & Powerplant analyses are suitable for coverage by the Zonal Inspections. Those that are not are returned to the originating Working Groups to be included as dedicated tasks within their respective programs.

Where required, the L/HIRF analysis procedure will normally be performed after the Zonal Inspections have been identified. Contrary to the handling of GVIs from the Systems/Powerplant and Structure Analysis Procedures, the L/HIRF WG will simply advise the Zonal WG of those Zonal Inspections that contribute to L/HIRF maintenance. Any GVI requirement not satisfied by the Zonal WG conclusions will be identified as a stand-alone L/HIRF task.

n) "Task Consolidation?"

This step in the procedure examines the potential for consolidation between the GVI tasks derived from the Enhanced Zonal Analysis and the Zonal Inspections determined after application of the Standard Zonal Analysis.

The result of this step may lead to:

- standalone GVIs of wiring (not included in Zonal Inspections), and/or
- Zonal Inspections (either consolidated Wiring/Zonal GVIs or Zonal GVI coming directly from the Standard Analysis)

The consolidation of GVI tasks has to take into account the access requirements and the interval of each task. The Working Group may conclude that a standalone GVI of the wiring may be justified if the Zonal GVI of the other systems within the same zone does not need to have such a frequent inspection.

The DETs of wiring within the whole zone or part of a zone are automatically dedicated tasks.

The Zonal Inspection tasks (whether consolidated or not) will define the Zonal Inspection Program. The standalone GVIs and the DETs will be introduced as dedicated tasks in the Systems & Powerplant program. Within MRB Reports, these may be introduced under ATA 20 with no Failure Effect Category quoted.

Proposal for wording in MRB Reports

Tasks arising from application of the enhanced zonal analysis procedure that are not covered by the zonal inspections are to be introduced in the Systems and Powerplant sections of MRB Reports. ATA Chapter 20 is recommended but an alternative position within the section may be determined by an ISC as more appropriate. Note that specific L/HIRF tasks arising from application of MSG-3 rev 2001 section 2-6 are also candidates for this section of the MRB Report.

Unlike other Systems and Powerplant tasks, the tasks in ATA 20 have no 'Failure Effect Category' number. They have however been derived from an analysis of the design in consideration of conditions assessed to have an effect on the ability of the aircraft to perform continued safe flight and landing. As such, these ATA 20 tasks deserve special attention. Since the tasks are intended to mitigate against age related factors, it is recommended that MRB Reports identify that such tasks shall not be cancelled or covered by zonal inspections even if in-service reliability programs indicate few or nil findings. This does not prevent adjustment of intervals according to experience nor does it prevent the operator including the task as the first step on a combined DET/GVI/Zonal job card. It does however ensure the task is not 'lost' in the years after focus is removed from wiring issues.

6.6 Text for inclusion in MSG-3 Guidelines

In accordance with ATSRAC tasking, Task 3SC has worked in conjunction with the ATA's Maintenance Program Sub-Committee in order to update the MSG-3 guidelines document to reflect new logic thus ensuring that closer attention is given to wiring during development of future MRB Reports. These Reports provide task/interval listing for inclusion in an operator's initial Maintenance Program.

The ATA took the opportunity to update the MSG-3 guidelines document to address several other issues. To achieve this in a timely manner, a dedicated MSG-3 WG was formed with representation from US operators, OEMs, and Regulators. At their Nov 1st meeting they discussed and agreed the following text for inclusion in the next revision.

Quote...

2-5. Zonal Analysis Procedure

Zonal inspections may be developed from application of the Zonal Analysis Procedure. This requires a summary review of each zone on the aircraft and normally occurs as the MSG-3 analyses of structures, systems, and powerplants are being concluded. These inspections may subsequently be included in a Zonal Inspection Program.

This Zonal Analysis Procedure permits appropriate attention to be given to electrical wiring installations. Thus, as well as determining zonal inspections, the logic provides a means to identify applicable and effective tasks to minimize contamination and to address significant wiring installation discrepancies that may not be reliably

detected through zonal inspection. These dedicated tasks may subsequently be included in the Systems and Powerplant program.

In top down analyses conducted under MSG-3, many support items such as plumbing, ducting, Other Structure, wiring, etc., may be evaluated for possible contribution to functional failure. In cases where a general visual inspection is required to assess degradation, the zonal inspection program is an appropriate method

2-5-1. Procedure

The following procedure may be used

- a. Divide the aircraft externally and internally into zones as defined in ATA iSpec 2200 (formerly ATA 100).*
- b. For each zone, prepare a work sheet that identifies data such as: zone location and access, approximate size (volume), type of systems and components installed, typical power levels in any wiring bundles, features specific to lightning/HIRF protection etc. In addition, assess potential for the presence of combustible material, either through contamination (eg dust and lint) or occurring by design (eg fuel vapor).*
- c. Develop rating tables to determine the repeat interval for a zonal inspection. Rating tables will permit the likelihood of accidental damage, environmental deterioration and the density of equipment in the zone to be taken into account.*
- d. For all zones containing systems installations perform a standard zonal analysis using the rating tables from paragraph (c) to define the extent and interval of zonal inspection tasks. Multiple zonal inspections may be identified for each zone with those having less frequent intervals requiring increased access requirements.*
- e. Identify zones that both contain electrical wiring and have potential for combustible material being present. For these zones, perform an enhanced zonal analysis that permits the identification of stand-alone inspections and tasks that minimize contamination by combustible materials. Rating tables addressing the potential effects of fire on adjacent wiring and systems, the size of the zone and the density of installed equipment may be used to determine the inspection level. General Visual Inspections may be found effective for the complete zone. Detailed Inspections may be found effective for specific items in a zone. Interval determination may be accomplished using rating tables that consider accidental damage and environment.*
- f. Detailed Inspections and tasks to minimize contamination should be included with the Systems & Powerplant tasks. Since these are not system specific and do not have a Failure Effect Category, introduction in a dedicated section of this program is suggested, for example, under ATA 20.*
- g. General Visual Inspections arising from the enhanced zonal analysis (paragraph e) may be compared with the Zonal Inspections determined from the standard zonal analysis (paragraph d). The former may be considered fully covered by the*

zonal inspection if the access requirement is the same and the proposed interval is at least as frequent. Otherwise, a standalone GVI should be included with the tasks identified in paragraph (f).

- h. General Visual Inspections arising from the analysis of systems, powerplants and structures may be compared with the Zonal Inspections determined from the standard zonal analysis (paragraph d). Work sheets should record the interval proposed in the originating analysis. These GVIs may be considered fully covered by the zonal inspection if the access requirement is the same and the proposed interval is at least as frequent. Otherwise, a standalone GVI should be included within the MSI or SSI from which it was identified.*
- i. General Visual Inspections arising from the analysis of L/HIRF may be compared with the Zonal Inspections determined from the standard zonal analysis (paragraph d). These GVIs may be considered fully covered by the zonal inspection if the access requirement is the same and the proposed interval is at least as frequent. Otherwise, a standalone GVI should be included within the Systems & Powerplant tasks as described in section 2-6-1.*
- j. Visual Checks may be considered covered by Zonal Inspections provided that the Systems Working Group that identified them consider that the failure would always be noted and addressed during a zonal inspection. Otherwise, the task should remain in the Systems & Powerplant tasks where specific attention can be drawn to the item.*
- k. All tasks developed through application of the standard zonal procedure (para d) should be included in a Zonal Inspection Program. For accountability purposes, any General Visual Inspection or Visual Check originating from application of systems, powerplant or structures analyses should be referenced in the MRB Report zonal task. To avoid giving unjustified attention to these items, this should not be indicated on task/work cards.*

A typical logic diagram is depicted in figure 2-5-1.1 and 2-5-1.2. This is provided as a guide and may be customized to reflect individual company policies and procedures.

2-5-2. Zonal Inspection Task Intervals

Accomplishment intervals are based on hardware susceptibility to damage, the amount of activity in the zone, and operator and manufacturer experience with similar systems, powerplants and structures. When possible, intervals should correspond to those selected for targeted scheduled maintenance checks.

For a given zone, more than one task may be identified. In this case, the frequency of inspection is inversely proportional to the amount of access required ie the more access required the less the frequency of inspection.

Unquote

Note that figures 2-5-2.1 and 2-5-2.2 are equivalent to figures 6.5.1 and 6.5.2 in this Report with the exception that figure 2-5-2.1 does not include the question (i) relating to proximity of wiring to flight control systems.

6.7 Composition of a Zonal Working Group

Traditionally, the members of Zonal Working Groups tend to be engineers that have a broad but non-specific knowledge of maintenance program engineering. There may also have been a tendency to have a bias towards structural specialists since they are generally more familiar with a zonal, rather than component specific, type of analysis.

The enhancement of the Zonal Analysis Procedure introduces a requirement for a Zonal WG having significantly different expertise than before. This point must be recognized by Industry Steering Committees when defining the composition of the WG. It is also necessary to emphasize the additional training that is likely to be required.

In addition to having engineers with a broad knowledge of aircraft maintenance and maintenance program development, it is expected that the WG will include engineers familiar with wiring installation and inspectors familiar with the type of degradation that they consider would be noted during a zonal inspection. To avoid over emphasis on wiring, care should be taken that appropriate knowledge is available to cover structure and other system/powerplant installations.

6.8 Recommendations from Chapter 6

Operators shall ensure that they have a dedicated Zonal Inspection section within their approved maintenance program that addresses both systems and structures. This may not have been developed for the original MRB Report and thus OEM's will be required to assist operators to develop appropriate zonal inspections.

OEM's shall apply the enhanced zonal analysis procedure to their in-service products in order to identify additional tasks to better address deterioration of wiring installations. Once developed, operators shall introduce these tasks into their maintenance programs.

STC holders shall update the instructions for continued airworthiness that they provided in support of their design changes. This shall be done through application of the enhanced zonal analysis procedure. Once developed, these shall be introduced in operators maintenance programs.

Where possible, tasks originating from application of the process shall be included in MRB Reports. Where, due to the age of the aircraft, this is not feasible, the recommendations shall be published in a document appropriate to the importance of the issue e.g. Service Bulletin.

Whatever method is used to promulgate the additional tasks from the enhanced zonal analysis, the accompanying text shall highlight that the tasks should not be consolidated within the zonal inspections at any time during the aircraft life.

Task 3SC recommend that, should any specific materials be proven to exhibit unacceptable combustion characteristics after removal of an ignition source, the FAA should follow-up any necessary actions with the concerned parties.

Chapter 7

7.0 Expectations of a Zonal GVI

Further to the non-intrusive inspections performed by the ASTF during their accomplishment of ATSRAC Task 1, it was suggested that the majority of findings recorded during their inspections would have (should have) been noticed during performance of a General Visual Inspection. That is to say, though the ASTF may have performed Detailed Inspections to accomplish their review, this level of inspection would not have been necessary to notice the majority of the discrepancies.

In view of this situation, Task 3 SC have concluded that their activity should not stop at defining a General Visual Inspection and its limitations but should also provide some guidance material as to what is expected to be seen and addressed during accomplishment of a zonal GVI. This information may then be used to enhance the training of analysts and inspectors thus helping to ensure a consistent performance and consequent improvement in the condition of the in-service airplanes.

7.1 Guidance for accomplishment of a Zonal GVI

A Zonal GVI requires a visual examination to detect obvious unsatisfactory conditions and discrepancies. It shall be performed from within touching distance unless otherwise noted, that being the distance from the examiner's eye to the area/item being inspected. Though flashlights and mirrors may be required to provide an adequate view of all surfaces, there is no requirement for equipment removal or displacement unless this is specifically called for in the access instructions. Paint and/or sealant removal is not necessary and should be avoided unless condition is suspect. Should unsatisfactory conditions be suspected, items may need to be removed or displaced in order to permit proper assessment.

It is expected that the area to be inspected is clean enough to minimize the possibility that accumulated dirt or grease might hide unsatisfactory conditions that would otherwise be obvious. Any cleaning that is considered necessary should be performed in accordance with approved procedures in order to minimize the possibility of the cleaning process itself introducing anomalies.

In general, the inspector is expected to identify degradation due to wear, vibration, moisture, contamination, excessive heat, aging, etc. and make an assessment as to what actions are appropriate to address the noted discrepancy. In making this assessment, the inspector shall take into account potential influence on adjacent system installations, particularly if these include wiring.

One of the findings from the ATSRAC Task 1 surveys is that some evident discrepancies have either not been addressed or have not been addressed in an appropriate way. These discrepancies would have been expected to be seen during accomplishment of general visual inspections. More guidance is thus considered necessary to clarify the type of deterioration that constitutes a discrepancy that is expected to be corrected. For this reason, Task 3 SC have developed the following lists that are recommended be included in

guidance material as an enhancement to material that addresses inspection of the main system components. It is emphasized that these lists are not intended to be exhaustive and may be expanded as considered appropriate.

Electrical installation

(also refer to AMM Chapter 20 Standard Practices)

Wire / Wire Harnesses

- Wire bundle/wire bundle or wire bundle/structure contact/chafing
- Wire bundle sagging or badly secured
- Wires damaged (large scale damage due to mechanical impact, overheat, localized chafing etc)
- Lacing tape and/or ties missing/incorrectly installed
- Wiring protection sheath/conduit deformity or incorrectly installed
- End of sheath rubbing on end attachment device
- Grommet missing or damaged
- Dust and lint accumulation
- Surface contamination by metal shavings / swarf
- Contamination by liquids
- Deterioration of previous repairs

Connectors

- External corrosion on receptacles
- Backshell tail broken
- Rubber pad or packing on backshell missing
- No backshell wire securing device
- Foolproofing chain broken
- Missing or broken safety wire
- Discoloration/evidence of overheat on terminal lugs/blocks
- Torque stripe misalignment

Switches

- Rear protection cap damaged

Ground points

- Corrosion

Bonding braid/bonding jumper

- Braid broken or disconnected
- Multiple strands corroded
- Multiple strands broken

Wiring clamps or brackets

- Corroded
- Broken/missing
- Bent or twisted
- Faulty attachment (bad attachment or fastener missing)
- Unstuck/detached
- Protection/cushion damaged

Supports (rails or tubes/conduit)

- Broken
- Deformed
- Fastener missing
- Missing edge protection on rims of feed through holes
- Racetrack cushion damaged

The following item could be considered to be covered by the ZIP if access to the electrical power center, relay boxes etc are added in the access requirements:

Circuit breakers, contactors or relays

- Signs of overheat

Hydraulic/Fuel/Water Waste/Oxygen/Fire Detection/Fire Suppression system installation

- Seepage/leakage of liquid
- Broken or incorrect wire locking
- Pipes badly secured
- Pipe/pipe or pipe/structure contact (check for chafing and restore separation)
- Missing or broken clamps
- Crushed / damaged pipes
- Broken/disconnected bonding leads / jumpers
- Deterioration of previous repairs
- Obstruction of smoke detectors
- Plugged or damaged distribution nozzles

Air systems installation

- Evidence of leakage on adjacent structure/components
- Crushed/split ducts
- Misaligned, missing or broken clamps
- Ducting badly secured

Mechanical systems installation

- Bent/crushed control rods
- Sagging control cables
- Excessively worn, frayed or kinked control cables
- Excessively worn fairleads
- Extruded bearing liners
- Broken or incorrect wire locking
- Significant corrosion on cables, threads

Cargo Systems

- Split/holed compartment liners
- Seal damage
- Excessively worn rollers (sign of jamming and resultant overheating)
- Missing/damaged stops/latches
- Damaged cargo net restraining attachments

Engines/Pylons

- Blade damage (e.g., nicks, cracks)
- Blades rub (on rubstrip)
- Vane damage
- Cowling damage
- Loose or migrating fasteners and bushings (due to vibration)
- Discoloration (due to heat damage)
- Foreign Object Damage (FOD)
- Damage due to birdstrike/ingestions

General

- Detached sealant
- Obstructed drainage holes
- Illegible labels
- Paint/surface protection in poor condition
- Evidence of lightning strike
- Evidence of FOD/bird strike
- Condensation in windows
- Window crazing
- Oil canning
- Pooled liquids

Chapter 8

8.0 Minimization of Contamination

8.1 Introduction

As defined in Subtask 3.3 of the Draft Aging Transport Systems Rulemaking Advisory Committee Terms Of Reference document dated 1/11/99, Task 3 Subcommittee (Task 3 SC) was tasked as follows:

'Establish improved maintenance practices to prevent contamination of wiring and connectors with metal shavings or other harmful solids or fluids during maintenance of other components or modifications and repairs of airplane structure. Include those practices in appropriate maintenance instructions and training. The practices are to be prepared in the form of guidance material by January 2000 and should be considered in the work of Task 5'.

This chapter of the Task 3 SC report is submitted to satisfy the requirements of Subtask 3.3.

Within the Task 3 SC, issues related to the intent of the task were addressed and the results are reflected in this report. One primary issue was that Task 3 SC agreed to expand the scope beyond "maintenance" to include routine servicing tasks. Physical/mechanical damage to wiring from accidental contact or maintenance activity was also included as a concern (in addition to contamination) based on findings identified in the Aging Systems Task Force Aging Transport Systems Task 1 and Task 2 (ASTF) Final Report, Part 1, Non-intrusive Survey Results and Conclusions. Several protections or cautions associated directly with wiring (cleaning or wiring, repair of wiring, etc) were also included in this report based on data in the ASTF Final Report, Appendix A, Non-Intrusive Electrical Survey Summary Forms – Tabulated Results. .

It should be noted that the elements of this chapter are primarily housekeeping issues - protect and clean up. Based on the ASTF Final Report, Appendix A, this is an area where operators or maintenance providers have been deficient. Task 3 SC believes that the protection and caution recommendations listed herein will likely have the greatest affect through training of personnel performing the related maintenance or servicing task. As indicated in the Recommendations section of this report, this information should be considered within ATSRAC Task 5 Subcommittee for inclusion in improved training programs.

The process used in developing this chapter is outlined below:

- Task 3 SC established a list of maintenance or servicing tasks where mechanical damage or contamination might occur. This was performed through brainstorming sessions with Task 3 SC members. The results of this are contained in Table 1.
- Task 3 SC members audited their existing resources (maintenance manuals, technical papers, etc.) for documented protection or caution recommendations associated with wiring and related components. Approximately 40 documents directly related to this effort were utilized.

- Protections or cautions from those documents were tabulated against each of the identified maintenance and servicing tasks.
- Task 3 SC evaluated each maintenance and servicing task for sufficient standard protection and caution data and produced standardized wording and additional protection and caution recommendations in some cases.
- Based on discussion and existing precedent, Task 3 SC recommended locations where each protection and caution is to be integrated.
- Based on discussion and existing precedent, Task 3 SC recommended methods by which this information should be implemented.
- The results were tabulated for this chapter.

8.2 Results

Items 1 through 12 (refer to table 1) contain details related to each maintenance or servicing task. These are the basis for recommendations in this chapter. The following is an explanation of the format:

Maintenance/Servicing Procedure:

This section identifies the item in Table 1 for which applicable maintenance or servicing recommendations are made

Protections or Cautions:

This section lists individual protection or caution instructions applicable to the issue listed in the section above.

Individual entries are not specifically classified as either a “Protection” or “Caution”. That classification is left to the discretion of the organization incorporating the item.

All protections or cautions listed are intended to be applied to all document locations identified below, unless noted otherwise.

Location:

Manuals, documents, etc. where the protections or cautions listed above are to be integrated.

Wet area (galley/lav/door) installation/modification and operation was included in the initial list of maintenance and servicing activities to be reviewed. Upon further analysis, it was determined that these areas are adequately addressed by Item 4 (Inclement Weather) and Item 8 (Servicing, modifying, or repairing waste/water systems).

Application of structural anti-corrosion products was also included in the initial list of maintenance and servicing activities to be reviewed. Upon further analysis by the group, it was determined that additional information regarding the long term effect of these products on wiring was necessary. There was no data from the non-intrusive inspection report that indicated structural anti-corrosion products adversely affect wiring. For this reason, a recommendation to evaluate these products is made in lieu of any specific protections or cautions.

Similar to application of structural anti-corrosion products, a question was raised within the group related to the benefits of pressure washing versus the concerns. Experience has shown that pressure washing is a superior method of cleaning certain areas of aircraft where some water impingement on wiring and electrical components is unavoidable. While Task 3 SC recommends avoidance of direct pressure spray onto wiring and electrical components as a general “best practice”, further data needs to be developed toward specific criteria and limitations for pressure washing to minimize adverse effects on wiring and electrical components (i.e. nozzle PSI, cleaning solution pH, and temperature)

As previously noted, for each Item where standardized wording and additional protection and caution statements are recommended, a list of recommended locations for these statements is included. In some cases, the recommendations are specified for "New Products" only. For further clarification, Task 3 SC submits the following example:

One recommendation is to include specific protection and caution statements in every maintenance manual procedure that removes or installs a component where wiring must be displaced or disconnected/reconnected.

While it is not logistically feasible to do this for existing aircraft, manuals being developed for a new aircraft could easily be tailored to include specific protection and caution statements in every such procedure. Therefore, this recommendation is specified for New Products only. Existing aircraft would have this information placed in AMM Chapter 20, Standard Practices, but not in the individual procedures throughout all chapters of the manual.

8.3 Recommendations

It is the Subcommittee's recommendation that the following actions be accomplished as a result of the this activity in response to ATSRAC Task 3.3:

As indicated in Items 1 through 12, protections or cautions should be added to the specified locations for each of the maintenance or servicing tasks listed.

Exceptions:

Those locations identified as “New Products” do not require retroactive incorporation of these recommendations on existing documents. Documents produced in the future should have these recommendations incorporated.

General Notes:

- Some deviation from the wording in these tables is acceptable provided the intent is satisfied.
- Locations listed may be generic terms for common industry documents and are not intended to exclude other documents used for the same purpose.
- There is no implied significance of the terms “protection” and “caution”.

- It is recommended that Air Transport Association's Spec 100/iSpec2200 standards be used for publishing where possible.
- Task 4 SC should provide guidance to the OEM on implementation for those locations identified as "Wiring Practices Manuals".

Standards for producing documents listed in the "Locations" section of Item 1 through 12 should be updated to ensure appropriate protection and caution information is incorporated into future documents. One example of a standard is ATA Spec 100/iSpec2200.

Ownership to comply with the two above mentioned recommendations (in bold) should exist as:

OEM:Service Bulletins, Maintenance Manuals, Structural Repair Manuals, Wiring Practices Manuals.

Operator/MRO:Engineering Orders, Ground Operations Manuals, De-Icing/Anti-Icing Manuals

Air Transport Association:Specification (Spec) 117

ATSRAC T5WG:Training Documents

FAA.....Advisory Circular (AC) 43.13-1B,

All Regulators:.....Relevant Supplemental Type Certificate (STC) Guidance Material

The FAA should be tasked with evaluating current structural anti-corrosion products for long-term effects on wiring. The results should be recommendations for, or against, the use of specific products on wiring given the high probability that wiring and electrical components will always be subject to some level of contamination by these products. Manufacturers of corrosion inhibiting compounds should be encouraged to adjust their products to minimize detrimental effects on wiring while preserving the highest levels of corrosion protection possible.

OEMs should be tasked with providing specific guidance for pressure washing to minimize adverse effects on wiring and electrical components (i.e., maximum pressures, minimum nozzle-to-surface distance, maximum cleaning solution pH, maximum temperatures of water, maximum air temperature, and rinse requirements). The results should be in the form of internationally accepted practices.

Carriage of livestock / hazardous materials

Task 3 SC concluded that adequate attention is already given to the importance of adhering to strict criteria when handling livestock and hazardous materials. This issue is already well recognized and it would be unwarranted to place further emphasis on the need to exercise specific precautions in these circumstances.

Nevertheless, a recommendation is made for OEMs/operators to examine existing documentation to ensure that appropriate and complete instructions are given with

respect to cleaning of any spillage that might occur despite the precautions taken. This documentation should emphasize the potential severity of deterioration caused to systems and structure by animal waste products, salt water, caustic chemicals, etc. Guidance should be given on the extent of the cleaning procedures since it is often insufficient to remove only the visible evidence of contamination.

The following table lists the issues for which recommended cautions or protection practices have been developed to minimize the risk of contamination or accidental damage to wiring installations.

ITEM Number	Maintenance or Servicing Task
1	Installation, repair, or modification (to wiring)
2	Repair or modification (to structure)
3	Application of anti-icing or de-icing
4	Inclement weather
5	Component removal/installation (relating to attached wiring)
6	Pressure washing
7	Cleaning of wiring components
8	Servicing waste/water systems (& repair)
9	Servicing oil systems (& repair)
10	Servicing hydraulic systems (& repair)
11	Gaining access
12	Component removal/installation (relating to adjacent wiring)
	Application of structural anti-corrosion products (*)
	Wet area (galley/lav/door) installation and operation (*)

(*) considered but subsequently deleted.

Table 1

Protection and Caution Recommendations

Item 1

Maintenance/Servicing Procedure:

Installation, repair, or modification to wiring

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Extreme care must be exercised and proper procedures used during installation, repair, or modification of wiring to ensure safe and reliable performance of the user system.

Proper wire selection, routing/separation, clamping configurations, use of splices, repair or replacement of protective coverings, pinning / de-pinning of connections, etc., must be performed in accordance with the applicable sections of the Aircraft Maintenance Manual, Wiring Practices Manual, or other approved documents.

In addition, special care must be taken to minimize disturbance of existing adjacent wiring during all maintenance activities. If wiring has to be displaced then special attention must be given to restoring the original installation after completion of the work.

Location:

Wiring Practices Manual, Chapter 20
Aircraft Maintenance Manual, Chapter 20
Training Documentation
ATA Specification 117
STC Guidance Material
AC 43.13-1B

Protection and Caution Recommendations

Item 2

Maintenance/Service Procedure:

Structural repairs or modifications

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Structural repair or modification activity inherently introduces tooling and residual debris that is harmful to aircraft wiring.

Displacement / Removal / Reinstallation of Wiring for Structural Access

Structural repairs or modifications often require displacement (or removal) of wiring to provide access to the work area. Even minor displacement of wiring, especially while clamped, can damage wire insulation which can result in degraded performance, arcing, or circuit failure.

If wiring must be displaced (or removed) for work area access, it must be adequately released from its clamping (or other restraining provisions) to allow movement without damage.

Protection From Mechanical Damage

Extreme care must be exercised to protect wiring from mechanical damage by tools used in structural repairs or modification.

Wiring located adjacent to drilling or riveting operations should be carefully displaced or covered to reduce the possibility of mechanical damage. If wiring has to be displaced then special attention must be given to restoring the original installation after completion of the work.

Protection from Structural Debris

Structural debris such as drill shavings, liberated fastener pieces, broken drill bits, etc., must not be allowed to contaminate wiring or electrical components. This type of contamination can cause severe damage to insulation and potential arcing by providing a conductive path to ground or between two (2) or more wires of different loads. Once contaminated, removal of this type of debris from wire bundles is extremely difficult.

Before initiating structural repairs or modification activity, the work area must be carefully surveyed to identify all wiring and electrical components that may be subject to contamination. All wiring and electrical components in the debris field must be covered

Protection and Caution Recommendations

Item 2 (continued)

to prevent contamination. Consideration to be given to using drills equipped with vacuum aspiration to further minimize risk of metallic debris contaminating wire bundles.

Clean electrical components and wiring after completion of work per applicable AMM procedures

Location:

Structural Repair Manual, Chapter 51
Service Bulletins (applicable, New Products)
Training Documentation
Operator/Repair Station Engineering Orders (applicable, New Products)
ATA Specification 117
AC 43.13-1B

Protection and Caution Recommendations

Item 3

Maintenance/Servicing Procedure:

Aircraft De-Icing or Anti-Icing

Protections or Cautions:

To prevent damage to exposed electrical components and wiring in areas such as wing leading & trailing edges, wheelwells, and landing gear, care must be exercised when spraying de/anti-icing fluids. Direct pressure spray can lead to contamination or degradation of electrical components and wiring and thus should be avoided.

Locations:

Aircraft De-Icing or Anti-Icing Manual
Training/Qualification for De-Icing or Anti-Icing personnel
ATA Specification 117

Protection and Caution Recommendations

Item 4

Maintenance/Service Procedure:

Inclement weather

Protections or Cautions:

Structure and systems in areas such as doorways, floors, access panels, servicing bays are prone to corrosion or contamination due to their exposure to the elements. Make sure that snow, slush, or excessive moisture is removed from these areas before closing doors or panels.

Remove deposits of snow/slush from any items (e.g. cargo containers) before loading in the aircraft.

During inclement weather, keep doors/panels closed as much as possible to prevent ingress of that snow, slush, or excessive moisture.

Locations:

Aircraft Maintenance Manual, Chapter 12
Ground Operations Manual
Training Documentation
ATA Specification 117

Protection and Caution Recommendations

Item 5

Maintenance/Service Procedure:

Component removal/installation (relating to attached wiring)

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Excessive handling and movement during removal and installation of components may be harmful to aircraft wiring.

Use connector pliers to loosen coupling rings that are too tight to be loosened by hand. Alternately pull on the plug body and unscrew the coupling ring until the connector is separated. Do not use excessive force, and do not pull on attached wires.

When reconnecting, special care should be taken to ensure the connector body is fully seated, the jam nut is fully secured, and no tension is on the wires.

Use protective caps on all connectors (plug or receptacle) when equipment is disconnected to prevent contamination or damage of the contacts. Sleeves or plastic bags may be used if protective caps are not available. Use of sleeves or plastic bags should be temporary because of the risk of condensation. It is recommended to use a humidity absorber with sleeves or plastic bags.

Displacement (or removal) of wiring to provide access to the work area is often required. Even minor displacement of wiring, especially while clamped, can damage wire insulation potentially leading to degraded performance, arcing, or circuit failure. If wiring must be displaced (or removed) for work area access, it must be adequately released from its clamping (or other restraining provisions) to allow movement without damage. Special attention must be given to restoring the original installation after completion of the work.

Locations:

Wiring Practices Manual, Chapter 20
Aircraft Maintenance Manual, Chapter 20
Aircraft Maintenance Manual, all procedures for removal and installation of components with attached wiring (New Products)
Training Documentation
ATA Specification 117
STC Guidance Material
AC 43.13-1B

Protection and Caution Recommendations

Item 6

Maintenance/Service Procedure:

Pressure Washing

Protections or Cautions:

To prevent damage to exposed electrical components and wiring in areas such as wing leading and trailing edges, wheelwells, and landing gear, care must be exercised when spraying water or cleaning fluids. Direct high-pressure spray can lead to contamination or degradation of electrical components and wiring and should be avoided.

Water rinse should be used to remove cleaning solution residue after washing. Breakdown of wire insulation may occur with long term exposure of wiring to cleaning solutions.

Locations:

Aircraft Maintenance Manual, Chapter 12
Training Documentation
ATA Specification 117

Protection and Caution Recommendations

Item 7

Maintenance/Service Procedure:

Cleaning of wiring components (in situ)

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Extreme care must be exercised and proper procedures used during cleaning to ensure safe and reliable performance of the user system.

Care must be taken to avoid displacement or disturbance of wiring during cleaning of non-aggressive contamination. However, in the event of contamination by aggressive contaminants (e.g, livestock waste, salt water, battery electrolyte etc) such displacement may be necessary. In these cases wiring should be released from its installation so as to avoid undue stress being induced in wiring or connectors. Similarly, if liquid contamination enters the bundle then ties should be removed before separating the wires.

Clean only the area and items that have contamination. Before cleaning, make sure that the cleaning materials and methods will not cause more contamination.

If a cloth is used, make sure that it is clean, dry, and lint-free

A connector must be completely dry before mating. Any fluids remaining on a connector can have a deteriorating affect on the connector or the system or both.

Locations:

Wiring Practices Manual, Chapter 20
Aircraft Maintenance Manual, Chapter 20
OEM/operator spill & cleanup procedures
Training Documentation
ATA Specification 117
AC 43.13-1B

Protection and Caution Recommendations

Item 8

Maintenance/Service Procedure:

Servicing, modifying, or repairing waste/water systems

Protections or Cautions:

- (1) Structure and systems in areas adjacent to waste/water systems are prone to contamination with subsequent corrosion from those systems. Care must be exercised to prevent any fluids from reaching electrical components and wiring while servicing, modifying, or repairing waste/water systems.

Operator practice may call for a weak acid solution to be periodically flushed through lavatory systems to enhance reliability and efficiency of operation. In view of the effect of acid contamination on systems and structure, the system should be confirmed to be free of leaks before using such solutions.

- (2) Structure and systems in areas adjacent to waste/water systems are prone to corrosion or contamination from those systems. Cover exposed electrical components and wiring during waste/water system modification or repair.

Locations:

- (1) Aircraft Maintenance Manual, Chapter 12
- (2) Aircraft Maintenance Manual, Chapter 38 (New Products)
- (1&2) Training Documentation
- (1&2) ATA Specification 117
- (1&2) STC Guidance Material

Protection and Caution Recommendations

Item 9

Maintenance/Service Procedure:

Servicing, modifying, or repairing oil systems

Protections or Cautions:

Structure and systems in areas adjacent to oil systems are prone to contamination from those systems. To minimize the attraction and adhesion of foreign material, care must be exercised to avoid any fluids from reaching electrical components and wiring while servicing, modifying, or repairing oil systems. Oil and debris in combination with damaged wiring can present a fire hazard.

(1)

Structure and systems in areas adjacent to oil systems are prone to contamination from those systems. Cover exposed electrical components and wiring during oil system modification or repair.

(2)

Locations:

- (1) Aircraft Maintenance Manual, Chapter 12
- (2) Aircraft Maintenance Manual, Chapter 70, 71, & 79 (New Products)
- (1&2) Training Documentation
- (1&2) ATA Specification 117
- (1&2) STC Guidance Material
- (1&2) AC 43.13-1B

Protection and Caution Recommendations

Item 10

Maintenance/Service Procedure:

Servicing, modifying, or repairing hydraulic systems

Protections or Cautions:

Structure and systems in areas adjacent to hydraulic systems are prone to contamination from those systems. To minimize the attraction and adhesion of foreign material, care must be exercised to avoid any fluids from reaching electrical components and wiring while servicing, modifying, or repairing hydraulic systems.

(1)

Structure and systems in areas adjacent to hydraulic systems are prone to contamination from those systems. Cover exposed electrical components and wiring during hydraulic system modification or repair.

(2)

Locations:

- (1) Aircraft Maintenance Manual, Chapter 12
- (2) Aircraft Maintenance Manual, Chapter 27, 29, 32, & 71 (New Products)
- (1&2) Training Documentation
- (1&2) ATA Specification 117
- (1&2) STC Guidance Material
- (1&2) AC 43.13-1B

Protection and Caution Recommendations

Item 11

Maintenance/Service Procedure:

Gaining access (entering zones)

Protections or Cautions:

When entering or working on the aircraft, care must be exercised to prevent damage to adjacent or hidden electrical components and wiring, including wiring that may be hidden from view (i.e. covered by insulation). Use protective boards or platforms for adequate support and protection. Avoid using wire bundles as handholds or support.

If wiring must be displaced (or removed) for work area access, it must be adequately released from its clamping (or other restraining provisions) to allow movement without damage and returned after work is completed.

Locations:

Aircraft Maintenance Manual, Chapter 20
Training Documentation
ATA Specification 117
STC Guidance Material

Protection and Caution Recommendations

Item 12

Maintenance/Service Procedure:

Component removal and installation (relating to equipment adjacent to electrical components and wiring)

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Excessive handling and movement during removal and installation of components may be harmful to aircraft wiring.

Component removal and installation often require displacement (or removal) of adjacent wiring to provide access to the work area. Improper displacement of wiring, especially while clamped, can damage wire insulation potentially leading to degraded performance, arcing, or circuit failure.

If wiring must be displaced (or removed) for work area access, it must be adequately released from its clamping (or other restraining provisions) to allow movement without damage and be subsequently returned after work is completed.

Locations:

Aircraft Maintenance Manual, Chapter 20
Training Documentation
ATA Specification 117
Service Bulletins (applicable, New Products)
STC Guidance Material

Chapter 9

9.0 Awareness Enhancement

The on aircraft inspections performed by ASTF (ATSRAC Task 1) highlighted that much of the improvement in the condition of wiring installations will come only with a revised attitude towards what is acceptable and what is not. Much of what has been found is clearly evident by general visual inspection and thus must have been considered acceptable deterioration.

Introducing new or revised repetitive maintenance tasks and updating maintenance practice guidelines can only result in improved levels of airworthiness if they are heeded and performed as recommended. The revisions proposed are logical and need no high level of understanding from the person performing the inspection. However, both accomplishment and any necessary corrective action require time. Time is frequently the one criterion that is not available to the inspector. Thus, whatever improvements are made in training and documentation, if the pressure of the workplace remains high, these remain only potential improvements and never get reflected in the condition of the airplane.

Task 3SC has identified a need to improve awareness throughout airline management of the importance of adequate performance of visual inspections, particularly those on wiring. Only when this has succeeded will sufficient time be allocated for task accomplishment and, where necessary, appropriate corrective action. This issue is applicable not only to operators but also to 3rd party maintenance organizations. Indeed, the intense competition amongst the latter has exacerbated the issue with aircraft possibly being returned 'on time' only due to truncation of the time consuming visual inspections.

It is recognized that a whole new culture needs to be put in place. This will not be achieved purely at the recommendation of one OEM or one Regulatory. It can only be reached if all operators have to embody the recommendations on all aircraft types simultaneously thus minimizing the impact on competitiveness.

The first accomplishments of the enhanced inspections are expected to highlight discrepancies requiring corrective action that had previously been considered as acceptable. Since the extent of these is likely to depend on the time in service, the older the airplane is the more corrective action is likely to be necessary. Similarly, the new cleaning (restoration) tasks will likely cause significant additional work for their first performance. Both the enhanced inspections and the new tasks will undoubtedly lead to a one-off increased downtime. However, once the condition of all airplanes is restored, the application of the repeat tasks is not expected to significantly increase the downtime. Additional resources may be required but all operators will be affected in the same way.

The purpose of this chapter is to highlight the need to encourage management from the airlines and 3rd Party maintenance organizations to understand the importance

of performing the enhanced zonal inspections. Only then will they give their inspectors sufficient time to accomplish them.

The first step to overcome this “learned complacency” is to educate management on the importance of performing the enhanced zonal inspections and additional maintenance practices (e.g., housekeeping tasks). While the training need not be as comprehensive as the program provided to the Inspectors, the management training should provide at a minimum:

- Reasons why the enhanced zonal inspections and additional maintenance practices should be done properly,
- Definitions of General Visual Inspections, Detailed Inspections, and Special Detailed Inspections,
- General overview of what to look for during a zonal inspections.

With this added awareness, the management staff will have obtained a better understanding of the enhanced inspections and additional maintenance. This information should be used by the airlines and 3rd Party maintenance organizations when developing their resource plans and production schedules. Management is also encouraged to witness some of the enhanced inspections first hand or review the results (findings) from these inspections on a continuous basis to ensure this awareness is maintained.

Production of a video

The importance of changing maintenance mentality towards electrical wiring installations will require more than simply updating manuals and enhancing training. The need for change must be promoted from above and thus actions must be taken to convince senior management that extended inspection time and improved working procedures are fundamental in achieving an improvement in continuous airworthiness.

FAA are recommended to promote the production of a video aimed at convincing senior management within OEMs, Operators and 3rd Party Maintenance Organizations of the need to change the attitude towards wiring. This may use footage already available from the ATA Spec 117 video and should be complemented by pictures of actual in-service conditions (e.g, still photos of dust/lint, degraded repairs, chafing etc). Film taken during laboratory testing should not be used. Film of arcing under test conditions has given appropriate motivation to those developing enhanced maintenance criteria but may not be perceived as realistic by those we need to convince. If this perception is allowed to develop it may degrade the impact of the message that has to be understood and acted upon. Focus must be on what does occur in service, what needs to be done to avoid it and why.

It is suggested that the message would be stronger if an Operator CEO could be found to provide an introduction to the video.

With respect to video distribution, lessons learned from the ATA Spec 117 video should be addressed. In order to ensure that all operators have access the cost should not discourage purchase.

Chapter 10

10.0 Continuous Airworthiness of Single Element Dual Load Path Design in Flight Controls

This chapter provides the results of the revised subtask 3.4 assigned to the Task 3 SC by ATSRAC. This was considered as 'Product 3' with the following objectives:

Based on task 3.4 (as modified by ATSRAC on Jan 19th, 2000), develop guidelines to permit appropriate attention be given to flight control dual load path design during development of the instructions for continued airworthiness. Propose a methodology that may be applied retrospectively to such features on in-service models.

10.1 Purpose

The purpose of this chapter is to provide the results of subtask 3.4 assigned to Task 3 SC. The objectives were to:

1. Determine if the existing maintenance and inspection criteria adequately addresses Single Element Dual Load Path design, including possible lack of awareness of a second load path and the accompanying difficulty in inspecting the second load path..
2. Make recommendations, if required, for enhanced maintenance inspection criteria.

This included reviewing the definition of Single Element Dual Load Path (SEDLP), determining where SEDLP parts are used, reviewing existing MSG-3 for SEDLP parts, and if necessary, suggesting how to update MSG-3 to better suit SEDLP items.

10.2 Review the definition of Single Element Dual Load Path (SEDLP)

For the purposes of the ATSRAC activity, the definition of SEDLP is:

An assembly having a primary and secondary load path, where both paths are an integral part of a single component (element).

Dual load path design in airplane flight controls is introduced to satisfy FAR 25.671 or equivalent design requirements. This implies that loss of both load paths may lead to loss of capability to perform continued safe flight and landing. Use of multiple components (e.g. parallel links) or single components may achieve such design principles.

Examples of single components include rod assemblies (with one path being an inner tube and the other being an outer tube) and plate assemblies (with one load path attached to the second path "back-to-back"). For this review, the only SEDLP parts of concern are those that MSG-3 defines as hidden safety i.e. Failure Effect Category (FEC) 8. However since many of these parts were designed prior to MSG-3, all flight

control SEDLP parts shall be considered using FEC8 logic unless individual analysis shows otherwise.

During Task 3 SC research, an additional type of part was found in some flight control systems that had an inner and outer rod similar to the one described above, except that the inner rod is the only load carrying path and the outer rod acts as a retainer. The retainer avoids a failed component falling into another system with potential for causing a jam. The failure of both the inner and outer components for this type of part may also result in an FEC8/hidden safety issue, and may thus need to be considered like the SEDLP parts discussed above.

By their design, SEDLP parts may not be easy to inspect visually by maintenance personnel.

10.3 Where SEDLP parts may be used

All examples of SEDLP found to date have been in the flight controls. Examples include input rods and bolts, and rudder feel and centering units. On newer model airplanes many of the SEDLP parts have been eliminated by newer design methods.

10.4 Review existing MSG-3 for SEDLP parts

MSG-3 was used to evaluate sample SEDLP parts. Task 3 SC found that, providing the function is correctly described, the existing logic can adequately evaluate the SEDLP items. Below is an example:

Questions from 'Level 1' of MSG-3 logic and sample answers for SEDLP parts:

1. Is the occurrence of a functional failure evident to the operating crew during the performance of normal duties?
No, the system functions normally with the loss of one load path. The loss of one path is not evident to the flight crew. Go to question 3.
2. Not applicable with a "No" in question 1.
3. Does the combination of a hidden functional failure and one additional failure of a system related or backup function have an adverse effect on operating safety?
Yes, the hidden functional failure i.e. the loss of one load path, and one additional failure, i.e. the loss of the remaining load path (or retainer clip), has an adverse effect on safety.
4. Not applicable due to previous answers.

This example identifies this part as a hidden safety item (FEC8). After that has been determined, the type of maintenance task for the part needs to be identified. Possible inspection of the parts could include general visual inspection, detailed inspection, special detailed (e.g. with borescope or equivalent), restoration (overhaul) or discard. The determination of the most appropriate task(s) will be dictated by the specific design and, where feasible, should be agreed by an OEM/airline working group.

It is recognized that some SEDLP designs may not be fully inspectable without disassembly. Since the disassembly process may result in damage that prevents reuse of some parts, Task 3 SC propose that, similar to structural inspections, an inspection of

visible areas may, exceptionally, be assessed as adequate to satisfy the MSG-3 logic in those areas. Examples of this are “back-to-back” parts.

10.5 Recommendation to ATSRAC for SEDLP items

Update MSG-3 to better address SEDLP items.

Even though the current MSG-3 logic is able to handle SEDLP items, if the person doing the evaluation does not understand that there is a secondary path and that this path may not be inspectable by a general visual inspection, they may fail to identify appropriate scheduled maintenance requirements. Task 3 SC recommends the following:

- a) A new paragraph is added to the MSG-3 chapter 2-3, Aircraft Systems / Powerplant Analysis Method .
Defining some functional failures may require a detailed understanding of the system and its design principles. For example, for system components having single element dual load path features, such as concentric tubes or back to back plates, the function of both paths should be analyzed individually. The degradation and/or failure of one path may not be evident

This proposal was considered and agreed by the ATA on Nov 1st for inclusion in the MSG-3 Rev 2001 document.

- b) An example MSG-3 analysis is added to the MSG-3 guidelines document to address the function of dual load paths in flight controls. This should be introduced when the concept of a ‘user’s handbook’ is developed.

Perform MSG-3 analysis on the dual load path functions of SEDLP components.

- c) Review existing MSG-3 analyses, and/or perform new MSG-3 analysis, on SEDLP components to ensure the dual load path function has been identified and analyzed with new awareness of the design principle.

Chapter 11

11.0 Consideration of Intrusive Inspection Conclusions and Recommendations

The Intrusive Inspection WG completed their initial consideration of the results of the intrusive inspections on selected wiring bundles after Task 3SC had submitted a revised maintenance task development logic to the ATA.

A review of the draft conclusions and recommendations (Chapter 7) was performed in the Task 3SC sixth meeting Nov 28th-30th. This draft was identical to that presented at the Oct 11th/12th ATSRAC meeting. For each of the 28 items, Task 3 SC prepared a statement that identified how the issue(s) had been taken into account. For some recommendations, it was noted that implementation into Task 3 SC maintenance criteria enhancements was not considered feasible and, in these cases, justification was given. This justification included the identification of recommendations that would mitigate the concern.

In summary, Task 3 SC believed that implementation of the range of improvements they have identified will, firstly, significantly reduce the probability of critical wiring deterioration and, secondly, minimize the risk of fire in the event that an ignition source should occur. As a result of their review of the Oct draft Chapter 7, Task 3 SC did not consider it necessary to adjust the enhanced zonal analysis procedure.

On Dec 19th, the Task 3 SC Chairman received an updated draft of the Intrusive Inspection WG's Conclusions and Recommendations. In accordance with the specific request from ATSRAC, this revised document provided recommendations directed to specific bodies. Those recommendations directed to Task 3SC now need to be addressed. Due to the need to dispatch the draft Task 3SC Final Report by Dec 22nd, it has not been possible to perform this action.

The following tables have been extracted from Chapter 7 of the Intrusive Inspection WG's Report. For each of the 15 recommendations directed at Task 3SC, text will be developed in early 2001 to indicate how the issues have been taken into consideration in the enhancement of maintenance criteria described in Chapters 5 to 10.

Table 7-5-1: Degraded Splice	
Situation	Recommendations
1. Any high current circuit with one of more of the conditions identified below.	<p>This finding is relatively infrequent. Pre-emptive replacement of spliced wire with new wire or the rework of splices can minimize the potential for repairs or splices to degrade beyond acceptable limits. Any repair should be accomplished using OEM/FAA approved methods and materials appropriate for the environment (which may exceed the requirements of originally approved practice for aged aircraft). Periodic diagnostic testing (e.g. resistance evaluation, time domain reflectometry) can help to identify failing (high resistance) repairs and splices.</p> <p>Recommendations: <u>Task Group 3:</u> None</p>
1a. Potential for high resistance heating, flammable materials	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. In this situation the potential for fire exists.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>
1b. Potential for high resistance heating, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. In this situation the potential exists for loss of several flight-critical systems.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>

Table 7-5-2: Heat Damaged or Burnt Wire	
Situation	Recommendations
2. Any situation with one or more of the specific conditions identified below	<p>This finding is relatively common. Localized heat damage (from external source or internal conductor heating) on adjacent wires may make these wires particularly subject to the formation of neighboring cracks and the potential for arcing or shorting. Visual Inspection can detect some conditions. Use of in-situ nondestructive testing methods may be used to detect additional insulation faults, especially if the heat damage effects a local area with several bundles, several wires within a single bundle, or a substantial length of a single wire.</p> <p>Recommendations: <u>Task Group 3:</u> <i>1) Modify the MSG3 process to include the consideration of potential heat sources when developing zonal inspection instructions</i></p> <p><u>Task 3SC position :</u> <i>To be considered in 2001 by another ATSRAC group</i></p>
2a. Flammable materials, cockpit or electronics bay.	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. Though the specific presence of moisture or contamination (to enable short circuiting) is not necessarily anticipated in this scenario, the specified zones and installations within these zones are critical enough to warrant extra care and precaution.</p> <p>Additional Recommendations: <u>Task Group 3:</u> <i>2) Investigate periodic, selective inspection and nondestructive testing of cockpit and electronics bay wiring.</i></p> <p><u>Task 3SC position:</u> <i>To be considered in 2001 by another ATSRAC group</i></p>
2b. Moisture, flammable materials, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. Effective intervention can include reduction of moisture intrusion and minimization of flammable materials in the proximity of susceptible installations. Installation of heat shielding to protect susceptible installations can eliminate or mitigate heat damage. Because embrittled wires can fail collectively, proper separation of critical system wiring is essential.</p> <p>Additional Recommendations: <u>Task Group 3:</u> <i>3) Investigate periodic, selective inspection and nondestructive testing of wire bundles supporting multiple flight critical systems.</i></p> <p><u>Task 3SC position:</u> <i>To be considered in 2001 by another ATSRAC group</i></p>
2c. Moisture, flammable materials	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. Effective intervention can include reduction of moisture intrusion, minimization of flammable materials in the proximity of susceptible installations, and installation of fire or heat barriers.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>
2d. Moisture, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. Though the presence of flammable materials is not anticipated in this scenario, the potential for a common mode failure of many or all wires in a single bundle warrants extra care and precaution. Effective intervention can include reduction of moisture intrusion and installation of fire or heat barriers. Proper separation of critical systems wiring will mitigate the consequence of collective wire failure.</p>

Table 7-5-2: Heat Damaged or Burnt Wire	
Situation	Recommendations
	Additional Recommendations: <u>Task Group 3:</u> None
2e. Flammable materials or contamination, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. The potential for a common mode failure of many or all wires in a single bundle warrants extra care and precaution.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>
2f. Flammable materials, multiple critical systems, vibration	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. Though moisture is not anticipated in this scenario, the potential for vibration (i.e. the relative motion of partially exposed conductors) to induce a common mode failure of many or all wires in a single critical bundle warrants extra care and precaution. Effective intervention can include reducing vibration potential with additional bundle security (clamps, ties, etc) and minimizing flammable materials in the proximity of susceptible installations.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>

Table 7-5-3: Vibration Damage or Chafing	
Situation	Recommendations
3. Any Situation involving one or more of the conditions identified below	<p>This finding is relatively common. If the chafing agent is a conductive to ground or if multiple adjacent wires are chafing, short-circuiting can occur even in the absence of moisture or a conductive contaminant (i.e. through direct physical contact). Augmenting general visual inspection with a detailed or directed visual inspection in critical areas can mitigate this condition. The necessity for rework or redesign may result from identification of chronic or widespread chafing condition. An AFCB can mitigate this condition by minimizing damage and preventing electrical fire.</p> <p>Recommendations: <i>Task Group 3:</i> <i>4) For these high consequence situations, specify more detailed inspection (possibly requiring some disassembly of support hardware) to ensure potential chafing problems are spotted and corrected.</i></p> <p><i>Task 3SC position:</i> <i>To be considered in 2001 by another ATSRAC group</i></p>
3a. Flammable materials or contamination, cockpit or electronics bay	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. Wire or wire bundle chafing in the presence of flammable materials in the cockpit or electronics bay could result in wire-to-structure or wire-to-wire shorting arcing resulting in fire. Flammable contaminants increase the potential for ignition. More emphasis on cleaning and prevention of fluid contamination (e.g. drip shields) can mitigate the risks presented by contaminants and aid in the detection of chafing conditions. Nondestructive testing can detect wire chafing (after significant dielectric breakdown) and aid in repair.</p> <p>Additional Recommendations: <i>Task Group 3:</i> <i>5) Develop situation-specific guidance to ensure the proper attention to protection and cleaning wire bundles. Develop guidance on the separation of wire bundles from non-fire-retardant materials.</i></p> <p><i>Task 3SC position:</i> <i>To be considered in 2001 by another ATSRAC group</i></p>
3b. Flammable materials or contamination, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. Wire chafing in the presence of flammable materials or contaminants with wires from multiple critical systems in close proximity could result in smoke and/or fire and loss of multiple flight-critical systems. Maintaining wire segregation for critical and redundant systems can mitigate the risk of multiple system failures. More emphasis on cleaning and prevention of fluid contamination (e.g. drip shields) can mitigate the risks presented by contaminants and aid in the detection of chafing conditions.</p> <p>Additional Recommendations: <i>Task Group 3:</i> <i>6) Develop situation-specific guidance to ensure the proper attention to protection and cleaning wire bundles. Develop guidance on the separation of wire bundles from non-fire-retardant materials.</i></p> <p><i>Task 3SC position:</i> <i>To be considered in 2001 by another ATSRAC group</i></p>

Table 7-5-3: Vibration Damage or Chafing	
Situation	Recommendations
3c. Multiple critical systems, arc tracking potential	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. Wire chafing with arc tracking potential and wires from critical systems in close proximity could result in arcing and propagation to other wires, smoke and/or fire, and loss of multiple critical systems which can lead to excessive crew workload.</p> <p>Additional Recommendations: <u>Task Group 3:</u> <i>7) Specify guidelines to ensure the proper attention to protection and cleaning wire bundles. Develop guidance to ensure the proper attention to protection of wire bundles.</i></p> <p><u>Task 3SC position:</u> To be considered in 2001 by another ATSRAC group</p>
3d. Flammable materials	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. Wire chafing in the presence of flammable materials can lead to arcing, smoke and /or in-flight fire and increased crew workload. Augmenting general visual inspection with a detailed or directed visual inspection in critical areas can mitigate this condition. Emphasis on minimizing flammable materials in close proximity to wiring can mitigate this condition.</p> <p>Additional Recommendations: <u>Task Group 3:</u> <i>8) Specify guidelines on the separation of wire bundles from non-fire-retardant materials.</i></p> <p><u>Task 3SC position:</u> To be considered in 2001 by another ATSRAC group</p>
3e. Contamination	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. Wire chafing in the presence of contamination can lead to arcing, smoke and /or localized. Augmenting general visual inspection with a detailed or directed visual inspection in critical areas can mitigate this condition. Emphasis on cleaning of contaminants can mitigate the risk of enhanced flammability and aids in the inspection process.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>
3f. Multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. Wire chafing with wires from critical systems in close proximity can lead to arcing and loss of multiple critical systems and increased crew workload. Augmenting general visual inspection with a detailed or directed visual inspection for bundles with multiple critical systems can mitigate this condition. Maintaining wiring separation for critical and redundant systems can mitigate the risk of multiple system failures.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>

Table 7-5-3: Vibration Damage or Chafing	
Situation	Recommendations
3g. Feeder cable	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. Chafing of a primary power feeder cable can lead to loss of a primary power source and violent arcing with damage to other systems and structure. Augmenting general visual inspection with a detailed or directed visual inspection (emphasizing the special requirements for integrity and configuration of power feeder cables) can mitigate this condition. Nondestructive testing can detect wire chafing (after significant dielectric breakdown) and aid in expedient repair. Because there are relatively few power feeder cables, more sophisticated testing is practical and should be specified.</p> <p>Additional Recommendations: <i>Task Group 3:</i> <i>9) Specify more detailed inspection and testing to ensure potential chafing problems are spotted and corrected.</i></p> <p><i>Task 3SC position: To be considered in 2001 by another ATSRAC group</i></p>

Table 7-5-4: Cracked Insulation	
Situation	Recommendations
4. Any situation involving one or more of the conditions identified below	<p>This finding is relatively common. Concentrations of cracks (through to the conductor) may under special circumstances result arcing or shorting. Visual inspection cannot be relied upon to detect cracks directly, and while testing technologies can detect certain bulk changes in insulation properties, there is no reliable and convenient means of identifying cracks¹. An AFCB can mitigate this condition by minimizing damage and preventing electrical fire.</p> <p>Recommendations: <u>Task Group 3:</u> None</p>
4a. Flammable materials, cockpit or electronics bay	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. Though moisture may or may not be present in this scenario, the specified zones and installations within these zones are critical enough to warrant extra care and precaution. If visual inspection is used, it should be supplemented by the removal of flammable materials from these locations.</p> <p>Additional Recommendations: <u>Task Group 3:</u> 10) Specify accelerated removal of flammable materials.</p> <p>Task 3SC position: <i>To be considered in 2001 by another ATSRAC group</i></p>
4b. Moisture, flammable materials, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. The potential for fire and multiple critical system failures exists. Multiple cracks in a localized area of a bundle serving multiple critical systems can also result in stray currents which adversely affect the functionality of those systems. If visual inspection is used, it should be supplemented by efforts to eliminate the potential for moisture intrusion and the removal of flammable materials. Maintaining wiring separation for critical and redundant systems can mitigate the risk of multiple system failures.</p> <p>Additional Recommendations: <u>Task Group 3:</u> 11) Specify accelerated removal of flammable materials. Specify guidelines to minimize moisture intrusion into wire bundles (e.g. specify drip shields over bundles running under lavatories). Specify guidelines to minimize moisture accumulation on or near bundles.</p> <p>Task 3SC position: <i>To be considered in 2001 by another ATSRAC group</i></p>
4c. Moisture, flammable materials	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. If visual inspection is used, it should be supplemented by efforts to eliminate the potential for moisture intrusion and the removal of flammable materials.</p> <p>Additional Recommendations: <u>Task Group 3:</u> 12) Specify guidelines to minimize moisture intrusion. Specify guidelines to minimize moisture accumulation on or near bundles.</p> <p>Task 3SC position: <i>To be considered in 2001 by another ATSRAC group</i></p>

Table 7-5-4: Cracked Insulation	
Situation	Recommendations
4d. Moisture, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. The potential for multiple critical system failures exists. Multiple cracks in a localized area of a bundle serving multiple critical systems can also result in stray currents which adversely affect the functionality of those systems. If visual inspection is used, it should be supplemented by efforts to eliminate the potential for moisture intrusion.</p> <p>Additional Recommendations: <u>Task Group 3:</u> 13) Specify guidelines to minimize moisture intrusion. Specify guidelines to minimize moisture accumulation on or near bundles.</p> <p>Task 3SC position: <i>To be considered in 2001 by another ATSRAC group</i></p>
4e. Contamination, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. Concentrations of cracks (through to the conductor) can (in the presence of some conductive contaminant) result arcing or shorting. Though flammable materials may or may not be present in this scenario, the potential for combustion (with flammable contaminants) or multiple critical system failures exists. In addition, multiple cracks in a localized area of a bundle serving multiple critical systems can also result in stray currents which adversely affect the functionality of those systems. If visual inspection is used, it should be supplemented by efforts to eliminate the potential for contamination (i.e. drip or splatter shields).</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>
4f. Flammable materials, multiple critical systems, vibration	<p>Given the specified conditions, the occurrence of this fault could lead to potentially severe consequences. Concentrations of large cracks (through to the conductor) can (if brought into physical contact by vibration) result arcing or shorting. In addition, vibration of cracked insulation can accelerate the degeneration of this condition. The potential for combustion or multiple critical system failures exists. In addition, multiple cracks in a localized area of a bundle serving multiple critical systems can also result in stray currents which adversely affect the functionality of those systems. If visual inspection is used, it should be supplemented by efforts to minimize exposure to flammable materials. Additional security (clamps, ties, etc) should be used to reduce the potential for accelerated damage and failure.</p> <p>Additional Recommendations: <u>Task Group 3:</u> 14) Specify accelerated removal of flammable materials. Establish guidelines to ensure, and enhance where necessary, the secure installation of wire bundles.</p> <p>Task 3SC position: <i>To be considered in 2001 by another ATSRAC group</i></p>

Table 7-5-5: Delamination	
Situation	Recommendations
5. Any situation involving one or more of the conditions identified below	<p>This finding is relatively infrequent. Delaminations (through to the conductor) may under special circumstances result arcing or shorting. Visual inspection may not be able to detect delamination. (Data on the visual detectability of delamination is very limited.) If visual inspection is used, it should be supplemented by efforts to eliminate the potential for moisture intrusion and efforts to minimize exposure to flammable materials. An AFCB can mitigate this condition by minimizing damage and preventing electrical fire.</p> <p>Recommendations: <u>Task Group 3:</u> <i>15) Specify guidelines that precipitate an invasive inspection or nondestructive testing of wire bundles exposed to suspected high or low pH contaminants. Specify guidelines for decontamination procedures for wire to neutralize the effects of chemically aggressive contaminants.</i></p> <p><u>Task 3SC position:</u> <i>To be considered in 2001 by another ATSRAC group</i></p>
5a. Flammable materials, cockpit or electronics bay	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. Though moisture may or may not be present in this scenario, the specified zones and installations within these zones are critical enough to warrant extra care and precaution.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>
5b. Moisture, flammable materials, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. The potential for fire and multiple critical system failures exists. If visual inspection is used, it should be supplemented by efforts to eliminate the potential for moisture intrusion and the removal of flammable materials. Maintaining wiring separation for critical and redundant systems can mitigate the risk of multiple system failures.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>

Table 7-5-6: Arcing	
Situation	Recommendations
6. Any situation involving one or more of the conditions identified below.	<p>This finding is relatively infrequent. Arcing can result from degraded or damaged wire or non-environmental or degraded splices. Because visual inspection will probably not detect initial arcing, efforts should focus on minimizing wire exposure to chafing, traumatic impact during maintenance operation in the area. Use of environmental splices can reduce the potential for a hazardous arc. Use of an AFCB can mitigate the consequences of arcing. Operational procedures, including Flight Standards Information Bulletin 00/08A, can also mitigate the consequences of initial failure.</p> <p>Recommendations: <u>Task Group 3: None</u></p>
6a. Flammable materials, cockpit or electronics bay	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. The existence of an arcing condition in the presence of flammable materials is unacceptable. The cockpit and electronics bay warrant special attention. Elimination of flammable materials can mitigate the consequences of arcing.</p> <p>Additional Recommendations: <u>Task Group 3: None</u></p>
6b. Flammable materials, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. The existence of an arcing condition in the presence of flammable materials is unacceptable. In addition to the fire threat, multiple critical systems may fail. Elimination or segregation of flammable materials can mitigate the consequences of arcing.</p> <p>Additional Recommendations: <u>Task Group 3: None</u></p>
6c. Contamination, cockpit or electronics bay	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. The existence of an arcing condition in the presence of flammable contaminants is unacceptable. The cockpit and electronics bay warrant special attention. Exposure of wire to fluid contaminants (e.g. water waste, hydraulic) and solid debris (e.g. drill shavings, foreign objects) must be minimized. Susceptible wire bundles should be kept free of flammable dust and lint build-up.</p> <p>Additional Recommendations: <u>Task Group 3: None</u></p>
6d. Contamination, multiple critical systems	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. The existence of an arcing condition in the presence of flammable contaminants is unacceptable. Exposure of wire to fluid contaminants (e.g. water waste, hydraulic) and solid debris (e.g. drill shavings, foreign objects) must be minimized. Susceptible wire bundles should be kept free of flammable dust and lint build-up.</p> <p>Additional Recommendations: <u>Task Group 3: None</u></p>

Table 7-5-6: Arcing	
Situation	Recommendations
6e. Multiple critical systems, arc-tracking potential	<p>Given the specified conditions, the occurrence of this fault could lead to potentially critical consequences. Though this scenario does not assume the presence of flammable materials or contaminants, arc-tracking on a bundle with multiple critical system wires can result in multiple flight-critical system failures. Separation of critical wiring into physically separate and smaller bundles can reduce the possibility of cascading failure.</p> <p>Additional Recommendations: <u>Task Group 3:</u> None</p>

Chapter 12

12.0 Recommendations and Conclusions

This chapter identifies the Task 3 SC recommendations that have evolved from their evaluation of enhancements to maintenance criteria in order to better address the continued airworthiness of (1) wiring installations (see paragraphs 12.1 to 12.5) and (2) single element dual load path features within flight controls (see paragraph 12.6).

In addition to the recommendations, an attempt has been made to indicate which organization is likely to have to take the lead in order that the recommendations be implemented.

12.1 Enhancement of Inspection Criteria

- 12.1.1 The ATA's Maintenance Program Development Document (that contains the MSG-3 guidelines) is to be updated to reflect the revised definitions of General Visual Inspection and Detailed Inspection. Target: MSG-3 rev 2001.

Action: ATA followed by IMRBPB

- 12.1.2 Training material utilized by regulators, OEMs, operators and 3rd party maintenance organizations to be updated to reflect the revised GVI/DET definitions

Action: Task 5WG plus Regulators, Operators, OEMs, 3rd party maintenance organizations

12.2 Maintenance Program Enhancement

- 12.2.1 Operators shall ensure that they have a dedicated Zonal Inspection section within their approved maintenance program. This may not have been developed for the original MRB Report and thus OEM's will be required to assist operators to develop appropriate zonal inspections.

Action: Operators (with assistance from OEM's as required)

- 12.2.2 OEM's shall apply the enhanced zonal analysis procedure to their in-service products in order to identify additional tasks to better address deterioration of wiring installations. Once developed, operators shall introduce these tasks into their maintenance programs.

Action: OEMs followed by Operators

- 12.2.3 STC holders shall update the instructions for continued airworthiness that they provided in support of their design changes. This shall be done through application of the enhanced zonal analysis procedure. Once developed, these shall be introduced in operators maintenance programs.

Action: STC holders followed by Operators

- 12.2.4 Where possible, tasks originating from application of the enhanced zonal analysis procedure shall be included in MRB Reports. Where, due to the age of the aircraft, this is not feasible, the recommendations shall be published in a document appropriate to the importance of the issue e.g. Service Bulletin.
Whatever method is used to promulgate the additional tasks, the accompanying text shall highlight that the tasks should not be consolidated within the zonal inspections at any time during the aircraft life.

Action: OEMs

- 12.2.5 Should any specific materials be proven to exhibit unacceptable combustion characteristics after removal of an ignition source, FAA should follow-up any necessary actions with the concerned parties.

Action: FAA

12.3 **Expectations of a Zonal GVI**

- 12.3.1 OEM/operator training material (for both aircraft inspection and MSG-3 analysis) and maintenance documentation (as appropriate) should include information on the typical deterioration that is expected to be seen and addressed during accomplishment of a zonal inspection. Chapter 7 identifies some items that should be included in addition to the main system components and structural items.

Action: Task 5WG plus OEMs, Operators, 3rd Party Maintenance Organizations

12.4 **Minimization of Contamination**

- 12.4.1 As indicated in Items 1 through 12 in Chapter 8.0, protections or cautions should be added to the specified locations for each of the maintenance or servicing tasks listed. See 'General Notes' under paragraph 8.3.

Action:

OEM: Service Bulletins, Maintenance Manuals, Structural Repair Manuals, Wiring Practices Manuals

Operator/MRO:	Engineering Orders, Ground Operations Manuals, De-Icing/Anti-Icing Manuals
ATA:	Specification (Spec) 117
ATSRAC	Task 5 WG: Training Documents
FAA:	Advisory Circular (AC) 43.13-1B
All Regulators:	Relevant STC Guidance Material

- 12.4.2 Standards for producing documents listed in the “Locations” section of Item 1 through 12 of Chapter 8 should be updated to ensure appropriate protection and caution information is incorporated in future documents. One example of a standard is ATA Spec 100/iSpec2200.

Action: Regulators, ATA

- 12.4.3 The FAA should be tasked with evaluating current structural anti-corrosion products for long-term effects on wiring. The results should be recommendations for or against the use of specific products on wiring given the high probability that wiring and electrical components will always be subject to some level of contamination by these products. Manufacturers of corrosion inhibiting compounds should be encouraged to adjust their products to minimize detrimental effects on wiring while preserving the highest levels of structural corrosion protection possible.

Action: Regulators (FAA lead)

- 12.4.4 OEMs should be tasked with providing specific guidance for pressure washing to minimize adverse effects on wiring and electrical components (i.e., maximum pressures, minimum nozzle-to-surface distance, maximum cleaning solution pH, maximum temperatures of water, maximum air temperature, and rinse requirements). The results should be in the form of internationally accepted practices.

Action: OEMs (preferably in consultation with each other)

- 12.4.5 With respect to Carriage of Livestock and Carriage of Hazardous Materials, OEMs/operators should examine existing documentation to ensure that appropriate and complete instructions are given with respect to cleaning of any spillage that might occur despite the precautions taken. This documentation should emphasize the potential severity of deterioration caused to systems and structure by animal waste products, salt water, caustic chemicals, etc. Guidance should be given on the extent of the cleaning procedures since it is often insufficient to remove only the visible evidence of contamination.

Action: OEMs and Operators

12.5 **Awareness Enhancement**

- 12.5.1 FAA to promote/finance the production of a video aimed at convincing senior management within OEMs, Operators and 3rd Party Maintenance Organizations of the need to change the attitude towards wiring. This may use footage already available from the ATA Spec 117 video and should be complemented by pictures actual in-service conditions. Film taken during laboratory testing should not be used. Focus must be on what does occur in service, not theoretical events.

Action: FAA

- 12.5.2 The importance of changing maintenance mentality towards electrical wiring installations will require more than simply updating manuals and enhancing training. The need for change must be promoted from above and thus actions must be taken to convince senior management that extended inspection time and improved working procedures are fundamental in achieving an improvement in continuous airworthiness.

Action: OEMs, Operators, 3rd Party Maintenance Organizations

12.6 **Continuous Airworthiness of SEDLP Design in Flight Controls**

- 12.6.1 Update MSG-3 to better address SEDLP items.
- a) Add a new paragraph to the ATA's MSG-3 chapter 3-3, Aircraft Systems / Powerplant Analysis Method to read:
Defining some functional failures may require a detailed understanding of the system and its design principles. For example, for system components having single element dual load path features, such as concentric tubes or back to back plates, the function of both paths should be analyzed individually. The degradation and/or failure of one path may not be evident
 - b) Add an example MSG-3 analysis is to the ATA's MSG-3 guidelines document to address the function of dual load paths in flight controls. This should be introduced when the concept of a 'user's handbook' is developed.

Action: ATA

- 12.6.2 Review existing MSG-3 analyses, and/or perform new MSG-3 analysis, on SEDLP components to ensure the dual load path function has been identified and analyzed with new awareness of the design principle.

Action: OEMs

12.7 **Other issues**

- 12.7.1 Task 3 SC identified an issue concerning circuit breaker performance that should be subjected to further investigation. The analysis of this electrical device did not fall within the evaluation of enhanced maintenance criteria for electrical wiring installations and hence is not addressed by Task 3SC in the earlier chapters of this Report.

The concern is related to a possible aging effect of certain types of CB that leads to welded contacts resulting in loss of function (with consequent potential for smoke generation). Cases were reported of CBs that could not be pulled and CBs that were apparently pulled but in fact did not break the circuit. Deterioration is accelerated when the CB is tripped with power on the circuit. It may be useful to issue advice to highlight this fact so that in-service maintenance and operational practices can be adapted to minimize the need for such an action.

In addition, infrequently used CBs may benefit from occasional operation in order to avoid age-related deterioration of the contact point.

FAA are recommended to initiate a study to determine if a general problem exists or whether it is related to a particular generation or type of CBs. Based on the results the need for further action may be assessed.

Action: FAA

Chapter 13

13.0 Abbreviations

AC	Advisory Circular
AFS	Aircraft Flight Standards
ASTF	Aging System Task Force (undertook ATSRAC Tasks 1a & 2)
ATA	Air Transport Association of America
ATSRAC	Aging Transport Systems Rulemaking Advisory Committee
CAA	Civil Aviation Authority
CB	Circuit Breaker
CIC	Corrosion Inhibiting Compounds
DET/DI	Detailed Inspection (alternative abbreviations)
DOD	Department of Defense
GVI	General Visual Inspection
EZAP	Enhanced Zonal Analysis Procedure
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FEC	Failure Effect Category (MSG-3 term)
FOD	Foreign Object Damage
HIRF	High Intensity Radiated Fields
IMRBPB	International MRB Policy Board
JAA	Joint Aviation Authorities
JAR	Joint Aviation Requirements
L/HIRF	Lightning/High Intensity Radiated Fields
MRB	Maintenance Review Board
MRO	Maintenance, Repair, Overhaul
MSG	Maintenance Steering Group
NASA	National Aeronautics & Space Administration
NTSB	National Transportation Safety Board
OEM	Original Equipment Manufacturer
PVC	Poly Vinyl Chloride
ROR	Record of Revision
SAE	Society of Automotive Engineers
SC	Sub-Committee
SDI/SDET	Special Detailed Inspection (alternative abbreviations)
SEDLP	Single Element Dual Load Path
STC	Supplemental Type Certificate
TOC	Table of Content
T3SC	Task 3 Sub-Committee (of ATSRAC)
WG	Working Group
WHCSS	White House Commission on Aviation Safety and Security
ZIP	Zonal Inspection Program

Swarf: British term for metal particles, generated from drilling and machining operations. Such particles may accumulate on and between wires within a wire bundle.

Appendix 1

Examples of application of the new Zonal Analysis Procedure

The prime goal of Task 3SC was to develop an enhanced zonal logic procedure which would be not only effective in achieving the objectives but which would also be practical to use.

Emphasis was put on using the various proposals developed during the year in order to identify limitations and areas where additional guidance would be beneficial. It was this iterative process that took much of the Task 3SC's time but it was considered essential that the product delivered to ATSRAC (and the ATA's MSG-3 WG) would work in practice.

Some changes were included in the logic very recently and thus certain aspects have received a less thorough review than others. It is thus expected that the initial use of the logic will highlight some issues that will need to be addressed at a future date. It is suggested that users note any difficulties they experience and ensure their Policy and Procedures Handbooks reflect their means to resolve the issues. These can then be discussed during either a future revision of the MSG-3 document or during the development of the MSG-3 User's guide.

Two examples of application of the logic are provided. Each has been produced independently by Airbus Industrie and Boeing. Though the presentation is very different, Task 3SC were satisfied that there is a high degree of consistency between them and commented that if more time was available it would appear possible to propose a common format.

Appendix 1a

Example from Airbus Industrie. The zone selected is the Forward Cargo Compartment on an A300-600 aircraft.

Appendix 1b

Example from Boeing. The zone selected is the Leading Edge to Front Spar Cavity from a typical current product line.

Note

These are examples developed by the OEM's Task 3SC representatives for the purpose of substantiating the logic procedure. Neither the OEM's designated task development team nor a Zonal Working Group has reviewed them and thus the results should not be considered as a recommendation.

A300-600	ZONAL EVALUTION SHEET	Zone 131/132
Effectivity	B4-600 (X) B4-600R (X) C4-600 (X) F4-600R (X) C4-605R Variant F(X)	
<p>Zone description: Fwd. Cargo Compartment between FR 20 and FR 38.2</p> <p>Installed equipment: Ceiling</p> <ul style="list-style-type: none"> - ATA 27 : Rudder, Elevator, Aileron cables, THS Trimm cables - ATA 29 : RAT Control cable - ATA 32 : MLG - Free fall extension cables - ATA 80 : Engine control cables - ATA 92 : Wire bundles <p>Sidewall</p> <ul style="list-style-type: none"> - ATA 21 : Riser ducts, Cargo compartment ventilation ducts - ATA 25 : Main deck drain pipes - P4/C4 <p>Floor:</p> <ul style="list-style-type: none"> - ATA 25: CLS system components (latches, PDUs, braking rollers) <p>Installed wire bundles: Ceiling :</p> <ul style="list-style-type: none"> - Galley power supply (XW Routing) - DC Generation and Distribution wire routing - Radar & Navigation & Communication wire routing - Radar & Navigation wire routing - Engine monitoring controls wire routing - Special electronics wire routing (antenna ATC1) - Special electronics wire routing (ATC2) - Fire protection wire routing - Air conditioning wire routing <p>Sidewall :</p> <p>Possible combustible materials in zone: dust/lint,</p> <p>Features influencing L/HIRF protection : shielded wires,</p>		
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A300-600	Enhanced Zonal Analysis (Wiring Inspection level definition sheet)	Zone 131/132
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Effectivity	B4-600 (X) B4-600R (X) C4-600 (X) F4-600R (X) C4-605R Variant F(X)
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Criticality of wiring assuming risk of ignition	
Characteristic	Rating
High	2
Low	1

Size of inspectable zone volume	
Characteristic	Rating
Big	3
Medium	2
Small	1

Density/congestion of installed equipment and structure in zone	
Characteristic	Rating
High	3
Medium	2
Low	1

1	2	3
1	1	3
3	2	3

1	2	3
1	1	3
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A300-600	Enhanced Zonal Analysis (Wiring inspection interval definition sheet)	Zone 131/132
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Effectivity B4-600 (X) B4-600R (X) C4-600 (X) F4-600R (X) C4-605R Variant F(X)	
--	--

Inspection Level selected: GVI () GVI/DET (X)	Perform for each inspection area an individual interval determination
--	---

Accidental damage (1-low probability, 2-medium, 3-high)	
Ground handling equipment	
F.O.D	
Weather effects (hail, etc)	
Frequency of maintenance activities	2
Fluid spillage	3
Passenger traffic	1
others	1

1	2	3
1	4C to 4C	2C to C
2	4C to 2C	2C to C
3	C to 4A	4A to 2A
		A and below

Environment (1-passive, 2-moderate, 3-severe)	
Temperature	
Vibration	
Chemicals (Toilet fluids, etc)	2
Humidity	2
Contamination	

1	2	3
1	4C to 4C	2C to C
2	4C to 2C	2C to C
3	C to 4A	4A to 2A
		A and below

1	2	3
1	4C to 4C	2C to C
2	4C to 2C	2C to C
3	C to 4A	4A to 2A
		A and below

Environment (1-passive, 2-moderate, 3-severe)	
Temperature	
Vibration	
Chemicals (Toilet fluids, etc)	2
Humidity	2
Contamination	

Wiring Task selected: 3	Task description DET Inspection of Galley supply wire	Interval C
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Enhanced Zonal Analysis

Zone 131/132

Effectivity	B4-600 (X)	B4-600R (X)	C4-600 (X)	F4-600R (X)	C4-605R Variant F(X)

Inspection Level selected: $GVI(X)$ $\frac{GVI}{DET}(X)$ Perform for each inspection area an individual interval determination

Environment (1=passive; 2=moderate, 3=severe)	
Temperature	
Vibration	
Chemicals (Toxic fluids, etc)	
Humidity	
Contamination	

Accidental damage (1=low probability, 2=medium, 3=high)	
Ground handling equipment	1
F.O.D	1
Weather effects (hail, etc)	1
Frequency of maintenance activities	1
Fuel spillage	1
Passenger traffic	2
others	2

1	8C to 4C	4C to 2C	2C to C	3
2	4C to 2C		2C to C	
3	C to 4A		4A to 2A	A and below

Wiring Task selected:	Task No.: 4	Task description: GVI of Wire	Interval: 1: 4C
Issue: Draft		Date: Nov.2000	
		Page: 6 of 8	

STANDARD ZONAL ANALYSIS SHEET

Zone 131/132

Environment (1-passive,2- moderate, 3- severe)
Temperature
Vibration
Chemicals (Toilet fluids etc)
Humidity
Contamination

	1	2	3
1		1	2
2	2	2	3
3	3	2	3

Note: details are not given on how the three tasks were derived

	1	2	3
1		1	2
2	1		2
3	2	3	

Importance	
High	1
Moderate	2
Low	3

	1	2	3
1	8C to 4C	4C to 2C	2C to C
2	4C to 2C	2C to C	C to 4A
3	C to 4A	4A to 2A	A and below

Task No.	Description	Interval
•	GVI of Cargo Compartment	A
•	GVI of Cargo Compartment	4C
•	GVI of Cargo Compartment	8C

A300-600

ZONAL ANALYSIS SHEET

Task Summary Sheet

Zone 131/132

Effectivity

B4-600 (X) B4-600R (X) C4-600 (X) F4-600R (X) C4-605R Variant F(X)

Wiring Inspection(s) from Enhanced Zonal Analysis:

Task Nbr.	Task Description	Access	Interval	Effectivity	Concept
1	Cleaning of Galley supply wire	131/132KC,JC	C	B4-600;B4-600R;C4-600	Z () S&P (X)
2	DET Inspection of Galley supply wire	131/132 KC, JC	C	B4-600;B4-600R;C4-600	Z () S&P (X)
3	GVI of wire	131/132 AZ to DZ AC,DC;FC;HC;KC	4C	All	Z (X) S&P ()

Zonal Inspections from Standard Zonal Analysis:

Task Nbr.	Task Description	Access	Interval
4	GVI of Cargo Compartment	811	A
5	GVI of Cargo Compartment	131/132 AZ to DZ AC,DC;FC;HC;KC	4C
6	GVI of Cargo Compartment	Sidewall, Ceiling linin	8C

Task(s) selected:

Task Nbr	Description	Access requirements	Interval	Effectivity	Remarks
1	Cleaning of Galley supply wire	131/132KC,JC	C	B4-600;B4-600R;C4-600	Transferred to S&P
2	DET Inspection of Galley supply wire	131/132KC,JC	C	B4-600;B4-600R;C4-600	Transferred to S&P
3	GVI of Cargo Compartment	131/132 AZ to DZ AC,DC;FC;HC;KC	4C	All	
4	GVI of Cargo Compartment	Sidewall, Ceiling	8C	All	

7X7 ENHANCED ZONAL ANALYSIS PROCEDURE DATA

IDENTIFICATION NUMBER	ZONAL ITEM: 5XX/6XX LEADING EDGE TO FRONT SPAR CAVITY.		
<p>FAILURE EFFECT QUESTIONS</p> <p>1. DOES ZONE CONTAIN WIRING? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO</p> <p>2. IS THERE ANY COMBUSTIBLE MATERIAL IN ZONE? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO</p> <p>3. IS THERE AN APPLICABLE AND EFFECTIVE TASK TO SIGNIFICANTLY REDUCE THE LIKELIHOOD OF ACCUMULATION OF COMBUSTIBLE MATERIALS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO</p> <p>4. DOES THE ZONE CONTAIN ANY POTENTIAL EFFECTS (CRITICALITY)? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO</p> <p>5. IS THE WHOLE ZONE AFFECTIVE? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO</p> <p>6 7 8 9</p>		<p>QUESTION # - ANSWER - EXPLANATION</p> <p>1. YES 4 leads at 28 volts DC</p> <p>2. YES Fuel vapor from the fuel tanks.</p> <p>3. NO The fuel vapor is always present in the leading edge.</p> <p>4. YES Faulty wire could ignite the fuel vapor.</p> <p>5. NO Only location around the fuel panel</p>	
<p>DEFINE TASK AND INTERVAL</p> <p>DEFINE DETAIL INSPECTION FOR WHOLE ZONE</p> <p>DEFINE DETAIL INSPECTION FOR EFFECTIVE AREA</p> <p>DEFINE GVI ZONAL TASK</p>		<p>8. Perform detail inspection of the wiring in the area of the panel in ATA 20 at 2C (15 mos.) Interval.</p> <p>9. Internal: Perform Zonal Inspection of Left Wing Leading Edge to Front Spar Compartment at 2C (15 mos.) Interval</p> <p>Internal: Perform Zonal Inspection of Right Wing Leading Edge to Front Spar Compartment at 2C (15 mos.) Interval</p>	

EXAMPLE

Boeing Interval Analysis Worksheet
Leading Edge to Front Spar Cavity – Detailed Inspection

EXAMPLE

Damage (1 - Low Probability, 2 - Medium, 3 - High)	2	
Ground Handling Cargo Handling Maintenance Activities Passenger Traffic Weather Effects (Hail, etc.) F.O.D. Fluid Spillage Other		

Inspectability (1 - Good, 2 - Adequate, 3 - Poor)	2	
Density/Congestion of Systems and Structures Difficulty of Access Lighting Visibility Comfort of the Person Doing the Inspection Other		

	1	2	3
I	1	1	2
N	2	2	2
S	3	2	3

	1	2	3
1	8-12 years 36000-48000 cyc	4-8 years 12000-36000 cyc	1-4 years 2000-12000 cyc
2	4-8 years 12000-36000 cyc	1-4 years 2000-12000 cyc	6 mos-1 year 300-2000 cyc
3	1-4 years 2000-12000 cyc	6 mos-1 year 300-2000 cyc	1-6 mos 300-2000 cyc

Interval Table

Aging (1 - No Degradation, 2 - Some, 3 - Substantial)	2	
Vibration Temperature (exposure to temp cycles/extremes) Atmosphere (UV, humid, saline, dirt/dust, rain, etc.) Chemicals (Affect of chemicals over time) Wind Abrasion Other		

Environment (1 - Good, 2 - Moderate, 3 - Severe)	2	
Trapped Liquid Temperature (extremes) Water and Dirt Splashed from Runway Chemicals Atmosphere Pressurized Other		

	1	2	3
E	1	1	2
N	2	2	2
V	3	2	3